An Integrative Biological Assessment of Sites in the Custer National Forest Ashland Ranger District

A Report to
The Custer National Forest, Ashland Ranger District

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Custer Forest Integrative Assessment Executive Summary

The objectives of this study were to: 1) Survey aquatic macroinvertebrate communities of selected sites within the Custer National Forest (Ashland Ranger District) as a continuing baseline survey and biological assessment; 2) Test the temporal stability of small spring macroinvertebrate metrics with revisits to established reference sites; 3) Examine the relationships among riparian plant, amphibian and macroinvertebrate communities; and 4) Evaluate management practices that will benefit the long-term sustainability of community integrity at these sites.
Riparian habitat assessments and plant, amphibian and macroinvertebrate surveys were performed at 14 lotic (stream) sites and 2 lentic (pond) sites within the Ashland District of the Custer National Forest. Five additional lentic sites and 1 spring were visited for macroinvertebrates samples only. Four stream sites (3 spatially identical reaches and 1 site further upstream) were revisited from 2004 to evaluate the temporal stability of macroinvertebrate metrics for determining biological integrity.

Plant Communities. 142 plant species were identified from the 2005 riparian surveys. Average species richness per site is 34. Ash Creek upper, Charcoal Creek, Cow Creek lower and upper were the most diverse riparian plant sites with >43 species. The SOC (G5/S1, USFS sensitive species) plant, *Carex gravida*, was reported at 2 sites, Cow Creek upper and Stocker Branch.

Macroinvertebrate Communities: Overall, 111 macroinvertebrate taxa were reported from all 2005 sites. Average macroinvertebrate taxa richness per site was 25 and the highest taxa richness reported at 2 sites was 38. Using the macroinvertebrate multimetric index (MMI), 5 of the 16 sites were ranked non-impaired (good to excellent biological integrity), 6 were slightly-impaired and 5 moderately-impaired. Cow Creek upper and Stocker Branch contain reference condition macroinvertebrate communities.

Amphibian and Reptile Communities: Herpetofauna surveys in conjunction with the macroinvertebrate surveys identified 8 species across the 16 sites. Four amphibians (the Tiger salamander, Woodhouse's Toad, Boreal Chorus Frog and the Northern Leopard Frog) and 4 reptiles (Painted Turtles, Eastern Racer, Gopher Snake and the Terrestrial Garter Snake) were recorded during the surveys. Woodhouse's Toad had the highest site occupancy rate at 31%. Cow Creek Reservoir remains the hotspot for herpetofauna with 5 species.

Integrative Communities: Overall, diverse plant and macroinvertebrate communities with high biological integrity are all highly correlated with good vegetative riparian coverage, and high habitat quality ranked with the EPA Habitat Quality Index. Number of herpetofauna species, breeding amphibians and more tolerant macroinvertebrates are all highly correlated with high livestock use, increased stream wetted width, more emergent instream vegetation, increased sedimentation and bare ground in the riparian area. The likely result of cattle intrusions in the spring riparian areas, and their associated effects of increasing wetted width, emergent vegetative area, percent in-stream sediments, and percent bare ground is to negatively affect the biological integrity of riparian plant and macroinvertebrate communities, while providing more breeding habitat for amphibians.

Community Integrity results from the plant, habitat and macroinvertebrate surveys combined to rank the Cow Creek reach upstream of Cow Creek Reservoir the most ecologically intact site, followed by the Stocker Branch reach, and the Charcoal Creek 2005 site. We recommend choosing these as integrator and future monitoring sites and should be managed for their high diversity and integrity as Northwestern Great Plains Perennial Spring ecosystems.
Additional sites that have high ecological potential to recover if cattle exclusion occurs, include Cow Creek below the reservoir, Little Brian Spring #1, Brian Spring #2, Ash Creek Spring down, and Liscom Butte upper.

ACKNOWLEDGEMENTS

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INTRODUCTION

In the last 200 years, cultivation, livestock grazing and other anthropogenic activities have destroyed 80% of the riparian corridors along North American and European streams and other water bodies (Naiman and Dechamps 1997). Riparian zones are not only highly diverse ecotones (Naiman et al. 1993, Manguson 1999), but they represent the last interface before particles and terrestrial inputs enter the aquatic ecosystem (Wenger 1999). Human-induced landscape changes may be the greatest contributing factor for the decline of our ecological resources, especially our aquatic ecosystems. Habitat destruction and alteration of the physical structure of the habitat is 1 of the 5 biggest threats to aquatic ecosystem health and biodiversity (Karr and Chu 1999).

In most cases, dramatically altering the quality of the watershed landscape will degrade the stream ecosystem it is spatially connected with, including the biological communities (Allen et al. 1999). In the absence of an undisturbed catchment, a naturally vegetated, intact riparian zone is viewed as critical to maintaining the biological integrity of the stream ecosystem (Gregory et al. 1991). In a study of Michigan rivers, the number of upstream disruptions to the riparian corridor was more important than the width of the vegetated riparian zone (Goforth et al. 2002), although disturbed riparian communities promoted invasive species within the terrestrial and aquatic ecosystems. Restoration of conditions to a pre-human impact state is virtually impossible in most aquatic systems (USEPA 1998). A more practical water quality goal would be to reduce the frequency and intensity of disturbances in the watershed. To maintain aquatic habitat integrity, 10-30 meters (35-100ft) of native riparian buffer should be preserved along all streams, including intermittent and ephemeral channels (Wenger 1999). In heavily grazed areas of the west, fenced areas that restricted animals from the riparian zone showed improved stream bank integrity and far less bank failure, thus minimizing erosion (Beschta & Platts 1986).

Aquatic macroinvertebrates and fishes are commonly used as bioindicators of ecosystem health, because their abundance, diversity, presence or absence, and community structure are greatly influenced by water and habitat quality (Barbour et al. 1999). Benthic macroinvertebrate biomonitoring has become a ubiquitous term among aquatic scientists and watershed managers (EPA 2004). Their use in "multimetric biotic indices" (IBI's) which may also include chemical, physical and other biological attributes, has been the cornerstone of many biomonitoring programs at the state and federal level (Karr 1993). As our knowledge of macroinvertebrate tolerance levels to certain stressors expands, we are better able to make causal inferences when shifts in the community occur. In a Montana aquatic community classification project, Stagliano (2005) defined the Northwestern Great Plains (NWGP) Perennial Spring ecological system, and derived the expected macroinvertebrate communities of reference and degraded stream types.

Many of these NWGP perennial spring sites were described from sites sampled in a study performed on the Custer National Forest in 2004 (Stagliano 2004).

This current study examines the structure and function of riparian plant, amphibian & aquatic communities associated with selected perennial springs and other aquatic habitats of the Ashland District of the Custer National Forest. We will examine the relationships among riparian plant, amphibian and macroinvertebrate communities in the context of habitat and biological integrity, and the presence of species of special concern (eg. Forest Service sensitive species). Future inventory surveys should focus on sampling other spring sites, identifying additional reference sites and monitoring sites with effective management of cattle (i.e. fencing) along riparian areas.

STUDY SITES

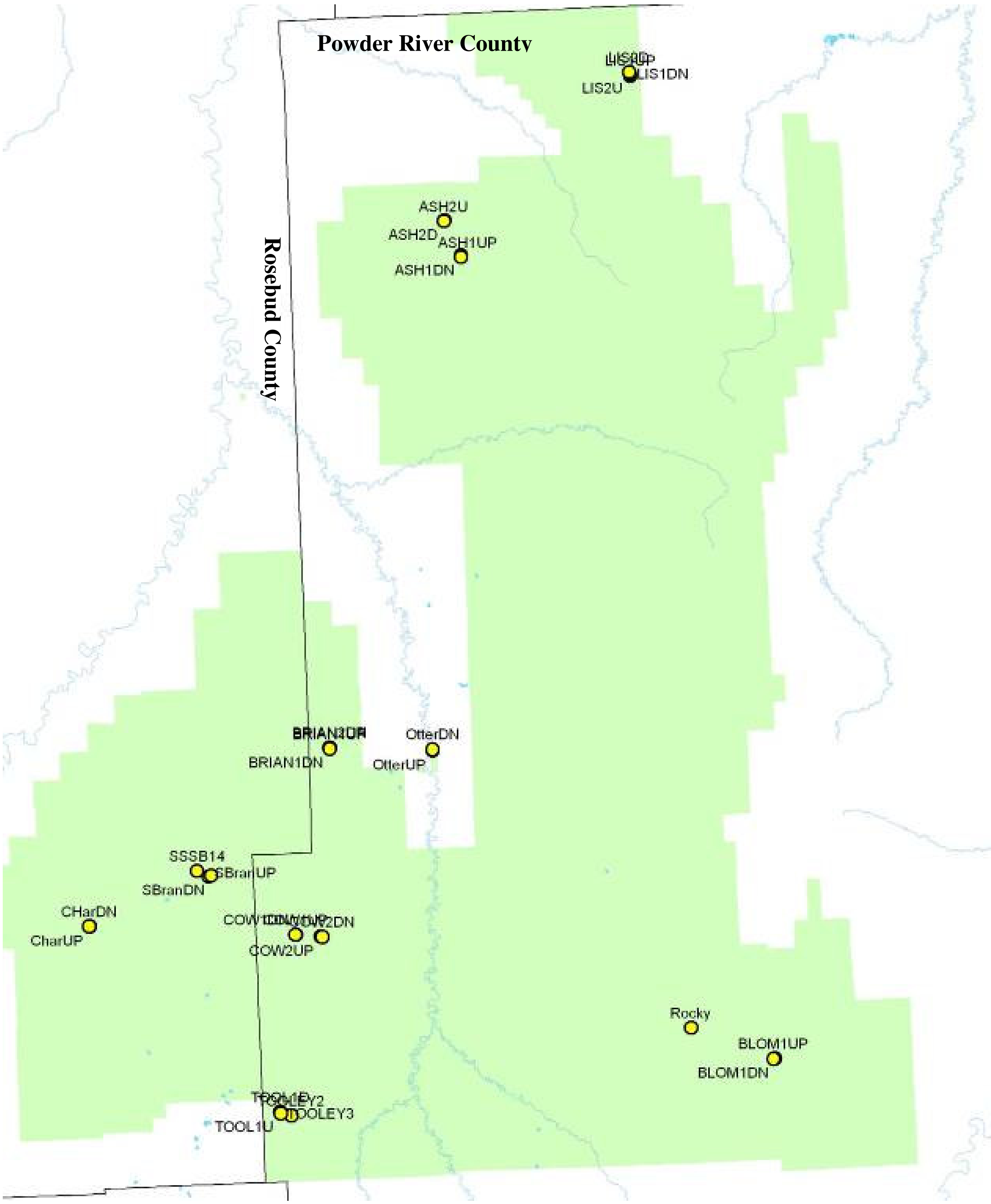
Stream sites (Table 1, Map 1) were chosen with the help of Don Sasse and from previous experience on the forest with the presence of water and accessibility to National Forest Lands. Of the 14 stream sites sampled in 2005, 4 of these (Charcoal, Cow Creek upper and lower, and Otter Creek) were sampled in 2004 and will be compared for community stability across time. The Stocker Branch stream site was sampled in 2004 for habitat, amphibians and macroinvertebrates, and in 2005 for riparian plants.

Table 1. Macroinvertebrate Sample Sites visited in 2005

GPS code	Description	Latitude	Longitude	Date sampled	Elevation (ft)
COW1UP	Cow Creek above reservoir	45.309	-106.250	5/20/2005 12:34	3911
COW2UP	Cow Creek below Res. Across from bog	45.308	-106.231	5/20/2005 13:42	3747
RockyCr	Rocky Crossing Reservoir nr. Diamond Butte	45.251	-105.960	5/21/2005 8:38	3994
CharUP	Charcoal Creek above reservoir	45.318	-106.402	5/21/2005 12:34	3868
ASH1DN	Ash Creek north near Cook Mountain	45.662	-106.105	5/6/2005 19:23	3638
ASH2D	Ash Creek north near Cook Mountain	45.680	-106.117	5/7/2005 8:04	3397
BeaverCR	Beaver Creek state section	45.757	-106.104	5/7/2005 10:00	3007
BLOM1UP	Bloom Creek in the Powder Drainage	45.233	-105.900	5/20/2005 16:33	3778
BRIAN1UP	Brian Spring South near King Mountian	45.406	-106.219	5/20/2005 9:50	3429
BRIAN2UP	Brian Spring Nouth near King Mountian	45.407	-106.219	5/20/2005 10:35	3443
OtterUP	Otter Creek @ old CCC camp	45.403	-106.142	5/21/2005 12:34	3208
LIS1UP	Liscom Butte Spring above road	45.752	-105.973	5/7/2005 13:05	3619
LIS2DN	Liscom Butte Spring below road	45.753	-105.973	5/7/2005 13:27	3617
SSSB14	Stocker Branch spring on side of rd	45.345	-106.321	5/21/2005 14:07	3955
SBranUP	Stocker Branch 2004	45.341	-106.313	5/21/2005 15:00	3955
TOOL1U	Tooley Creek pools secion 19 Otter Creek	45.216	-106.267	5/21/2005 10:00	3742
O'Dell Res	O'Dell Reservoir	45.331	-106.344	5/21/2005 14:38 P	4024
Taylor Creek	Taylor Creek Reservoir	45.226	-105.959	5/20/2005 15:35:	3937
Fairy Shrimp Pools	Fairy Shrimp Pools near Antelope Creek Well	45.218	-105.944	5/21/2005 9:48	4027
HazelRes	Hazel Creek Reservoir	45.226	-105.923	5/21/2005 10:20	3954
PokerJimRe	Poker Jim Reservoir	45.301	-106.343	5/21/2005 15:38:0(	3954

Taylor Creek, O'Dell, Hazel Creek and Poker Jim Reservoirs were sampled for macroinvertebrates using the multi-habitat dipnet protocols, but these have not been processed due to time and money constraints. We will report the herptofauna seen during these site visits, but macroinverts will be reported at a later date.

Map 1. Spatial distribution of integrative sites within the Ashland District of the Custer National Forest.



Streams flowing west & northwest to the Tongue River include Ash, Beaver Creek, Charcoal Creek, Stocker Branch, Liscom Butte, while those flowing east, Cow Creek, Tooley, Brian Springs, are tributaries to Otter Creek which flows into the Tongue River (~20 river miles downstream) at the town of Ashland. The Bloom Creek Site flows into the Powder River. Most stream sites surveyed ranged from 1st to 2nd order streams, except Otter and Beaver Creek which were 3rd & 4th order streams with an "island" of National Forest ownership and a state section access point within a mostly privately owned reach. Selected sites were evaluated quickly to determine if water was present and aquatic habitats exist. A 100-meter reach of stream or at least 40x average wetted width (Barbour et al. 1999) was designated as the sampling site. All of the following procedures were performed within this study reach.

METHODS

Habitat Evaluation. The evaluation of habitat quality is critical to the assessment of ecological integrity; biological diversity and stream habitat integrity have been shown to be closely linked (Raven 1998). We expected most measures of stream community integrity to be positively correlated with higher quality habitat parameters. Physical habitat characterization was evaluated with BLM's Habitat Assessment Field Data Sheet (Vinson and Hawkins, Buglag website, 2002) and EPA's Rapid Habitat Assessment Form (Barbour et al. 1999)(Fig.1). The BLM visual-based assessment method examines physical parameters such as stream morphology, channel incisement, bare ground and substrate characterization, as well as a rating scale for the condition of the riparian area, vegetation quality, and overall reach condition. The BLM assessment is based on 6 parameters (scored 1-worst to 4-best for a best possible reach score of 24).

Figure 1. Recording on-site habitat data, transect line in the background (Photo by Don Sasse).

The EPA Habitat Assessement is based on 10 habitat variables (instream fish cover, epifaunal substrate, pool substrate characterization, pool variability, channel alteration, sediment deposition, channel sinuosity, channel flow status, bank condition, bank vegetative protection, riparian vegetated zone width) and was completed for each sampled reach. Hereafter this site rating scale will be known as the (EPA HQI) and the best possible score is 200. Since the HQI integrates habitat metrics that range from stream channel incisement and widening to the immediate condition of the riparian area, it is a good measure of the overall reach habitat condition that can be measured consistently among sites. The LUI (Livestock Use Index) was also incorporated into the riparian habitat assessment, this involves a zig-zag walk from the bottom of the reach on the left and right banks of the stream channel visually counting the number of cow pies, and noting if these are new or old (see BLMAssessment Sheet: http://www1.usu.edu/buglab/forms/Bug%20Protocol.pdf). The amphibian crew also qualitatively rated the site as to the grazing pressure on a scale of 0-3 (zero=no grazing→3-intensive grazing impacts).

Aquatic & Terrestrial Sampling Methods

Plant Surveys.

Riparian vegetation inventories were conducted along the portion of the stream reaches generally delimited by the provided GPS coordinates. Along this reach, surveys were confined to the riparian area as defined by the irregular and sometimes gradual boundaries formed by the riparian-influenced vegetation as compared to the typical upland vegetation of the surrounding area. Within this riparian zone, vascular plant species observed were recorded by lifeform (trees, shrubs, gramminoids, forbs) with associated ocular estimations of their percent vegetative cover: 01=<1% cover, 03=1 to 5% cover, 10=5 to 15%, 20=15 to 25%, 30=25 to 35%, 40=35 to 45%, 50=45 to 55%, 60=55 to 65%, 70=65 to 75%, 80=75 to 85%, 90=85 to 95%, 98= >95%. Vegetation surveys were NOT conducted using any systematic sampling procedure but were conducted as walk-throughs of the riparian areas as defined above. The surveys recorded all species readily observed at the site, including all non-native species encountered. Searches for species of concern were also conducted. Digital photos of the riparian vegetation were taken usually at the upstream and downstream ends of the reach. The Riparian Habitat or Community Type (s) were noted for each area following Hansen et al (1995 & 1988). For complete community type descriptions see: http://nhp.nris.state.mt.us/community/guide.asp. Finally, additional notes helpful in documenting or characterizing the site were recorded.

Amphibian Surveys.

Amphibian species were recorded at the sites on the day of the macroinvertebrate surveys as incidental observations, and on a separate amphibian crew visit following sampling protocols used by Bryce Maxell in previous USFS surveys (Maxell 2004). These methods are typically timed, visual encounter surveys (Olson et al. 1997, Heyer et al. 1994) where the entire delineated riparian area or pond are wholly searched and then the time for that search is recorded (Figure 2). The presence of herpetofauna species was noted while walking the stream reach or pond, as well

Figure 2. Timed visual encounter survey for amphibians.

as identifying mating vocalizations in the vicinity of the riparian sampling reach.

***Aquatic Macroinvertebrate Collection*.**

Benthic macroinvertebrate samples were intensively collected from targeted riffle habitats (cobble/pebble substrates) using a WildcoDipnet™ with 500-micron mesh. A total of 8 samples (each 1ft^2) were taken in each reach and composited into a single sample starting at the most downstream riffle and working upstream. For example, if the study reach contained 3 riffle/pool complexes, 3 replicate samples would be taken from 2 riffles and 2 would be taken from the 3rd riffle. The dipnet is held downstream from the area being sampled and all cobble, pebbles and sediments within the 12 x 12" area are disturbed and scrubbed by hand and all organics were allowed to drift into the net (see fig. 3). The net contents are collected on a 500 micron sieve and placed in a 1L Nalgene container filled with 95% Ethanol (ETOH) for preservation. If shallow riffle areas were not present, EPA's multi-habitat dipnet protocol (7.2 in Barbour et al 1999) was used to sample aquatic invertebrates from all substrates and microhabitats within the reach (i.e. deep pools, undercut backs, logjams and macrophytes). A multi-habitat dipnet sample was taken with 20 (½ meter) jabs along evenly spaced transects in proportion to the habitat types with a 500 micon mesh, long-handled dip net. Contents of the net were washed thoroughly, and placed in 1 liter Nalgene sampling jars filled with 95% EtOH. Samples were brought back to the Helena lab, processed and identified (genus/species level) using protocols and taxonomic resources outlined in Barbour et al. (1999) and Bukantis (1998). A minimum target of 500 organisms was established, although many sites had far fewer invertebrates despite the entire sample being processed. Sites with abundant organisms (Cow Creek sites, Charcoal, Otter and Tooley Creek) were sub-sampled following standard protocols (Bukantis 1998, Barbour et al. 1999).

Figure 3. Macroinvertebrate quantitative sample being collected in Cow Creek (Photo by Don Sasse).

Total aquatic invertebrate species richness (Taxa Richness) and the EPT Richness (total number of Ephemeroptera, Plecoptera and Trichoptera taxa) were reported for each site. The MTBI (Montana Invertebrate Biotic Index) was calculated from the sample. The MTBI calculation involves the use of tolerance values of the organisms (ranked 0-10, based on Bukantis 1998 & Barbour et *al.* 1999), or their tolerance to degraded conditions. Invertebrates intolerant or sensitive to disturbances are ranked lower (0-3), while those very tolerant to degraded conditions are ranked higher (7-10). The calculation of the MTBI involves multiplying the # of individuals of taxa $_{(i)}$ found in a sample (n^i) by that taxa's tolerance value

(TV^i) and summing all ($n^i TV^i$) in the sample. Finally, the $\Sigma\, n^i TV^i$ is divided by the total # of individuals in the sample (TN) to derive the MTBI for the sample. Other metrics and metric scoring are included in Table 2a. Metric scores are added for the 8 macroinvertebrate metrics to obtain a final metric score, and this is compared to a known reference stream (the best possible score is 24). The percentage of this score can be used for the assignment impairment classification (see Table 2b). We can see that taxa richness measures such as EPT, # Predator taxa, and % EPT are expected to decrease with increased impairment, while the MTBI, %Collectors, and % Dominant taxa will increase with impairment.

Table 2a. Metrics used as biocriteria and the scoring criteria to determine impairment classifications for the Montana Plains ecoregions (Bukantis, 1998).

Metrics	Scores			
	3	2	1	0
TAXA RICHNESS	>24	24-18	18-12	<12
EPT RICHNESS	>8	8-6	5-3	<3
MT BIOTIC INDEX	<5	5-6	6-7	>7
% Dominant Taxa	<30	30-45	45-60	>95
% Collecters	<60	60-80	80-95	>95
%EPT	>50	50-30	30-10	<10
% Scapers + Shredders	>30	30-15	15-3	<3
# Predator taxa	>5	4-5	3-4	<3

Table 2b. Assignment of impairment classification based on metric performance.

% Comparibility to reference or BPS*	Classification
>75%	**Nonimpaired (NON)**
54-74%	**Slightly impaired (SLI)**
21-54%	**Moderately impaired (MOD)**
<20%	**Severely impaired (SEV)**

*BPS-Best Possible Score

Integrative Riparian Quality Analysis. Spearman's Rank correlations were run in SPSS (1999, Statistical Package Software for Windows) to investigate the associations among riparian plant, amphibian and macroinvertebrate communities, habitat quality parameters and floristics. We set the p-value of significance at $\alpha = 0.05$, but also ran these correlations with the p-value of $\alpha = 0.01$, too delineate the more robust relationships.

AQUATIC COMMUNITY RESULTS & DISCUSSION

Habitat Quality. Riparian habitat quality measured by the BLM HQI varied from a low score of 9 in a heavily cow-impacted stream reach (Ash Creek Spring upstream) to a perfect 24 at the Cow Creek Upper site (cover photo) (Table 3). The average BLM HQI score for the 18 stream sites was 17.2. This indicates most sites had a slight impairment of the riparian condition, usually by cattle intrusions and trampling along the stream, which led to bank failure, increased stream wetted width (WW) and sedimentation.

Table 3. Macroinvertebrate Sample Site Habitat Evaluation and Stream Morphology. Colored shading represents geomorphologically similar stream types

Site Name	BLM Site Score	EPA Site Score	% Bare Ground	Reach Length (m)	Reach Avg. Wetted Width (m)	Reach Avg. Depth (cm)	% Riffle	% Run	% Pool	% Boulder	% Cobble	% Pebble	% Gravel	% Sand	% Silt
AshCreek_D	12	118	25	40	1.97	27	0	20	80	0	10	0	5	0	85
AshCreek_U	9	85	75	100	1.65	6	0	0	100	0	0	0	0	0	100
Beaver Creek	15	125	25	100	3.2	25	10	10	80	0	10	10	20	0	60
Bloom Creek	11	111	40	100	3	10	10	50	20	20	10	10	0	0	60
Brian Spring1	17	143	10	40	0.95	3	10	70	20	0	10	20	26	0	44
BrianSpring 2	21	150	20	40	0.91	8	20	40	40	0	13	20	30	0	37
Charcoal Creek 2005	22	144	10	40	0.4	5	70	20	10	20	30	25	12.5	0	12.5
Charcoal Creek 2004	17	138	10	40	0.68	5	80	10	10	10	20	20	30	10	10
Cow Creek Res	NA*	125	0	NA*	25	NA*	NA*	NA*	NA*	0	0	0	0	0	100
Cow Creek_U 2005	24	166	0	40	1.2	4	80	20	0	20	50	10	15	0	5
Cow Creek_U 2004	21	168	0	40	0.84	4	80	20	0	25	40	20	10	0	5
Cow Creek_L 2005	16	130	0	40	2.44	8	50	40	10	0	30	20	20	0	30
Cow Creek_L 2004	18	124	0	40	0.9	5	70	20	10	20	25	25	20	0	10
Liscom Butte Down	20	126	0	40	0.25	5	80	20	0	0	30	10	10	0	50
Liscom Butte Up	12	94	20	40	2.2	18	10	10	80	0	0	0	3	0	97
Otter Creek 2005	20	153	20	100	3.1	22	10	70	20	0	10	20	20	20	30
Otter Creek 2004	18	155	20	100	3.1	19	10	70	20	0	10	10	30	20	30
Rocky Crossing Res	NA*	125	0	NA*	10	NA*	NA*	NA*	NA*	0	0	0	0	0	100
Stocker Branch 2004	17	142	5	40	0.67	6	60	30	10	0	15	35	40	0	10
Tooley Creek	21	154	10	100	2.5	25	0	10	90	5	5	5	5	0	80

NA*--Not applicable to Reservoirs

The EPA HQI varied from a low score of 85 in the degraded Ash Creek upstream site to the highest score at the Cow Creek Upper site of 168 (Table 3). The average EPA HQI score for the 18 stream sites was 134.7. The low average score (out of a best possible 200) indicates most sites had a slight-moderate impairment of the riparian and in-stream conditions. Since the EPA habitat protocols place an emphasis on evaluating fish habitat and pools, and most of these spring streams are naturally too small to contain pools to support fish, they will obviously rank lower than expected using this protocol. Although, the EPA protocol also addresses riparian bank vegetation, siltation and bank failure, which can lead to increased wetted width and instream sedimentation.

Most stream sites had an even mix of benthic substrates (cobble/pebble/gravel), except Ash Creek, Liscom Butte up and Tooley Creeks, which were predominately silted. In terms of overall stream morphology similarity, 3 distinct lotic groups were delineated (see color-coded Table 2): 1) Charcoal Creek, lower Lisom Butte, upper Cow Creek sites had mostly high-gradient, riffle habitat areas and higher percentages of larger substrates (boulder/cobble); 2) Stocker Branch and lower Cow Creek had more moderate-gradient, run habitat and a dominance of pebble and gravel substrates; 3) Otter, Tooley and Beaver Creeks were larger 3rd or 4th order streams (avg WW 2.75m) with low gradient, mostly-silted, runs & pools as the dominant habitat. Otter Creek is the largest perennial site typical of a low gradient, meandering northwestern prairie stream. The Charcoal Creek 2005 site ranked significantly higher in both habitat quality assessments than the 2004 site reach.

Plant Communities:

142 plant species were reported from the riparian surveys of 14 sites (Appendix B). Average species richness per site is 34. Ash Creek down, Charcoal Creek, Cow Creek lower and upper were the most diverse plant sites with 46, 46, 45 and 43 species, respectively (Table 5, Figure 3). These sites also had the highest % of native species and the highest Floristic Quality Indices (FQAI), except for Stocker Branch which had the second highest FQAI (24) behind Charcoal Creek's 25.8.

Amphibian and Reptile Communities:

Four amphibians: *Bufo woodhousii* (Woodhouse's Toad)(5 sites), *Pseudoacris maculata* (Boreal Chorus Frog)(4 sites), *Rana pipens* (Northern Leopard Frog)(3 sites) and *Ambystoma tigrinum* (Tiger salamander)(3 sites) in order of their site frequency occurrence were collected during this study. Four reptiles: Terrestrial Garter Snake (2 sites), Painted Turtle (2 sites), Gopher Snake (1 site) and Eastern Racer (1 site) were recorded during the surveys. Cow Creek Reservoir reported the most diverse herpetofauna with 5 species (Figure 4).

Fish Communities:

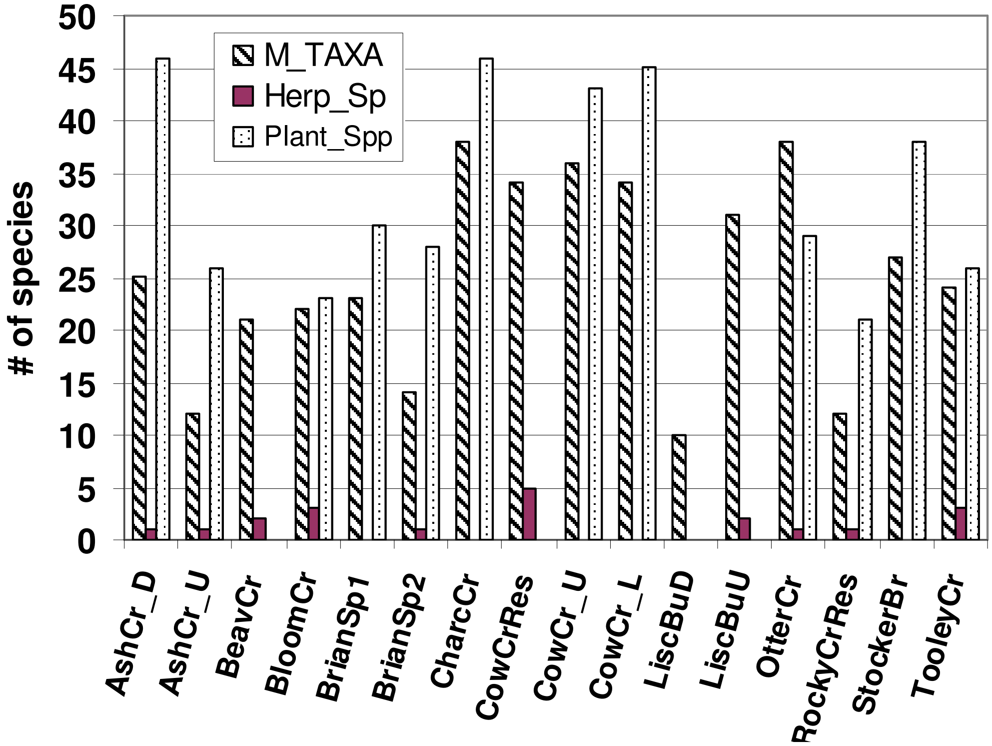
Otter Creek at the CCC Camp and Beaver Creek at the state section were the only lotic sites visited that had visible fish populations. Beaver Creek had a lake chub (*Couesius plumbeus*) population of individuals of various size-classes in 2 large pools (15-20m long) within the reach. Numerous minnows were seen while sampling in Otter Creek, but only a fathead minnow (*Pimephales promelas*) was collected during the dipnet sample that could be identified. Further investigation into the fish species present was not feasible at the time. Black bullhead were identified swimming in Poker Jim Reservoir, but none were collected.

Macroinvertebrate Community Diversity:

111 macroinvertebrate taxa were collected from all fourteen 2005 sites (118 from 12 sites in 2004), and the average taxa richness per site was 24; the most diverse sites were Otter and Charcoal Creek, each with 38 taxa, followed by Cow Creek upper with 36 taxa (see Table 4 & Figure 4). Otter Creek was the most diverse site in 2004 with 53 taxa. Charcoal (new site) and Cow Creek (resurvey) had 14 and 12 more taxa collected in 2005, respectively. Two interesting new taxa are reported from the 2005 Charcoal Creek site, the stonefly: *Amphinemura* (also collected from this years Cow Creek upper site) and the Dryopid beetle: *Helichus cf. lithophilus*. These are exciting discoveries because these species are fairly intolerant and

persist only in higher quality sites this far into eastern Montana. *Amphinemura* can persist in intermittent streams through a long egg-diapause period during the summer months, and perform much of their growth in the fall and winter months emerging in May (Stewart and Stark 1993). This early emergence may be the reason we did not collect them last year at the Cow Creek upper site or lower Charcoal Creek Site. Liscom Butte spring pool upstream had 31 taxa overall and a high diversity of beetles with 11 species. Most lotic sites had “typical” small spring stream macroinvertebrate communities with the order Diptera comprising a large portion of the taxa of all communities: the biting midges, Ceratopogonidae and many species of non-biting midges, Chironomidae were present in all streams; snails of the genera, Physella and Gyraulus were found in 8 and 7 sites, respectively (Appendix A). The most ubiquitous taxa found in all 14 of the surveyed 2005 sites was the Oligochaeta family Tubificidae, followed by the Dytiscid beetle genus: *Agabus* reported at 10 sites. The mayfly, *Baetis tricaudatus* was found in only three of the small streams, Cow Creek upper and lower and Charcoal Creek. Two caddisflies, *Hesperophylax cf. designatus* and *Psychoglypha,* found last year in streams with clean gravel substrate and large cobbles were found again this year at the Cow Creek sites, the new Charcoal Creek site, Otter and Beaver Creeks.

Figure 4. Total macroinvertebrate taxa (M_Taxa), herpetofauna (Herp_sp) and plant species reported at each 2005 integrative site. Sites with no plant data were not visited by the Botanist.



Macroinvertebrate Community Metrics.

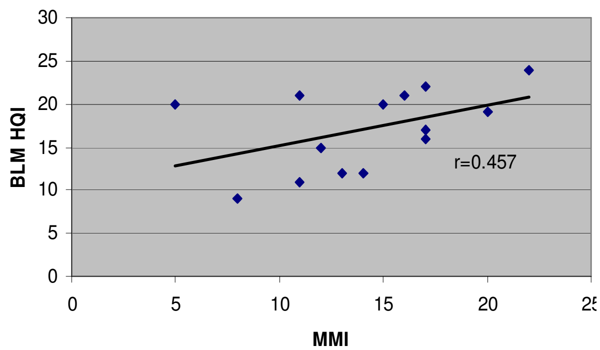
In terms of macroinvertebrate community, multi-metric analysis, Cow Creek upper and Stocker Branch are reference condition sites with excellent biointegrity, while Charcoal Creek, Cow Creek lower and Brian Spring #1 were classified as non-impaired, but not in the reference condition classification (Table 4). The only reason Brian Spring #1 made this category was the presence of the caddisfly, *Limnephilus* comprising a large percentage of the EPT organisms in the sample, which artificially boosted the EPT measures. Slightly-impaired (SLI) macroinvertebrate communities included Brian Spring #2, Otter Creek, Beaver Creek, Liscom Butte upper and Ash Creek Spring, in order of decreasing index scores (Table 4). Moderately-impaired sites (MOD) based on total metrics included Bloom and Tooley Creeks, while the lowest scoring (highly-impaired) sites within the MOD class were Ash Creek up, Liscom Butte DN and Rocky Creek Reservoir.

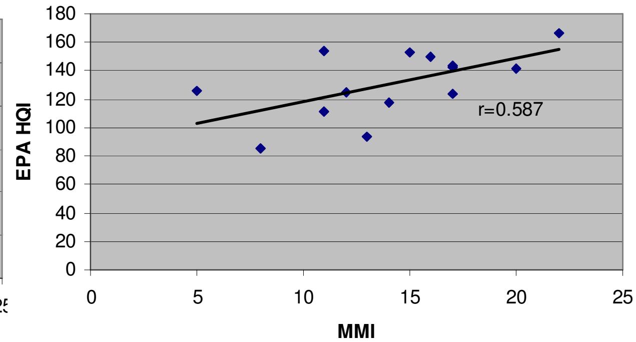
Table 4. Metric values and impairment classifications for the macroinvertebrate sample sites.

	Ash Creek Upper Quant 1/1	Ash Creek Lower Quant 1/1	Beaver Creek Qual 1/1	Bloom Creek Quant 1/1	Brian Spring 1 Qual 1/1	Brian Spring 2 Quant 1/1	Charcoal Creek Quant 9/16	Cow Creek Upper Quant 5/6	Cow Creek Lower Quant 7/30	Liscom Butte Dn Quant 1/1	Liscom Butte UP Qual 1/2	Otter Creek Qual 1/10	Rocky Creek Res. Qual 1/1	Stocker Branch Quant 1/1	Tooley Creek Qual 3/4
METRIC VALUES															
TAXA RICHNESS	12	25	21	22	23	14	38	36	34	10	31	38	12	27	24
EPT RICHNESS	0.00	1.00	2.00	0.00	1.00	3.00	3.00	4.00	3.00	0.00	0.00	4.00	0.00	4.00	1.00
MT BIOTIC INDEX	7.21	6.58	7.32	8.21	5.70	5.17	5.46	4.38	4.69	5.49	5.91	6.73	6.77	5.19	7.62
% Dominant Taxa	0.51	0.31	0.48	0.37	0.21	0.47	0.23	0.26	0.25	0.80	0.45	0.17	0.66	0.30	0.27
% Collecters	0.34	0.39	0.19	0.72	0.41	0.04	0.30	0.32	0.69	0.88	0.70	0.66	0.70	0.24	0.63
%EPT	0.00	0.03	0.05	0.00	0.19	0.28	0.15	0.53	0.26	0.00	0.00	0.02	0.00	0.43	0.00
% Scapers + Shredders	0.00	0.10	0.68	0.15	0.20	0.79	0.05	0.45	0.02	0.08	0.13	0.17	0.18	0.48	0.14
# Predator taxa	8	11	10	8	11	6	11	11	15	3	10	13	4	8	10
METRIC SCORES															
TAXA RICHNESS	1	3	2	2	2	1	3	3	3	0	3	3	1	3	2
EPT RICHNESS	0	0	0	0	0	1	1	1	1	0	0	1	0	1	0
MT BIOTIC INDEX	0	1	0	0	2	2	2	3	3	2	2	1	1	2	0
% Dominant Taxa	1	2	1	2	3	1	3	3	3	0	2	3	0	3	3
% Collecters	3	3	3	2	3	3	3	3	2	1	2	2	2	3	2
%EPT	0	0	0	0	2	2	1	3	2	0	0	0	0	2	0
% Scapers + Shredders	0	1	3	2	2	3	1	3	0	1	1	2	2	3	1
# Predator taxa	3	3	3	3	3	3	3	3	3	1	3	3	1	3	3
Final Metric Score	**8**	**13**	**12**	**11**	**17**	**16**	**17**	**22**	**17**	**5**	**13**	**15**	**7**	**20**	**11**
% of Reference Score	**36.4**	**59.1**	**54.5**	**50.0**	**77.3**	**72.7**	**77.3**	**100.0**	**77.3**	**22.7**	**59.1**	**62.5**	**31.8**	**90.9**	**50.0**
Criteria Classifications	**MOD**	**SLI**	**SLI**	**MOD**	**NON**	**SLI**	**NON**	**NON**	**NON**	**MOD**	**SLI**	**SLI**	**MOD**	**NON**	**MOD**

Macroinvertebrate Metric / Site Evaluation Relationships. The BLM Site Evaluation Score was fairly reliable in predicting impairment of the stream macroinvertebrate communities and the EPA HQI performed slightly better with correlation values of R =0.457 and R =0.587, respectively (Figure 5). Many sites ranked fairly high on the BLM/EPA Site scores, but still had poor macroinvertebrate metric scores. For example, the second highest macroinvetebrate index score (Stocker Branch-20) only earned a 17 on the BLM and 142 on the EPA site evaluation, while the lowest MMI index score (Liscom Butte DN-5) because of a recently colonized, tolerant invert community had highly ranked habitat quality (BLM-20).

Figure 5. Relationship between habitat site scores and multi-metric macroinvertebrate metrics (MMI). Correlation coefficient value (r) added below trendline.





Integrative Community Results & Discussions.

We evaluated 33 (9 aquatic macroinvertebrate, 10 plant community, 10 riparian, physical or habitat quality, and 4 amphibian) variables and indices (Table 5a & 5b). As expected, within their respective taxonomic groups, most of the individual riparian plant, amphibian and macroinvertebrate taxa measures are auto-correlated (i.e. # of EPT taxa with total # of invertbrate taxa; # of herpetofauna species with # of amphibian breeding species with Woodhouse's toad (BUWO) breeding; # wetland obligate plant species with # of facultative wetland plant species)(Table 6). But when we look outside of the particular taxonomic group, we can see some strong cross-disciplinary associations. Total macroinvertebrate taxa positively correlated at the α =0.05 level with the total # of plant species (R =0.56), %Native plant species (R =0.5), percent of perennials (R =0.56), and the FQAI (R =0.60) (Table 6). Of the macroinvertebrate variables correlating to the amphibian metrics, the Montana Biotic Index (MTBI) was positively correlated to the total # of herpetofauna species (R =0.70), BUWO breeding (R =0.75) and the # of any amphibians breeding (R =0.82) at the significance level of α =0.01. This association is meaningful because an increasing MTBI signifies an increasing tolerance of invertebrate organisms, which occurs when a spring site becomes degraded and conducive to amphibian breeding. Those relationships become even stronger if we analyze just the lotic sites without the 2 pond sites (R =0.81, 0.85 & 0.88, p<0.01) respectively. In fact most of the macroinvertebrate metric relationships to the other physical/habitat and amphibian variables become stronger when we analyze the data without the lentic sites. This is predictable because most of the macroinvertebrate metrics were developed in lotic systems and not many lentic bioassessment tools are available.

Table 5a. Metrics recorded during Macroinvertebrate Surveys used in the correlation analysis. T_Taxa=total macroinvertebrate taxa, EPT_T=Ephemeropter, Plecoptera, Trichoptera taxa richness, MTBI=Montana DEQ Biotic Index, %_Dom=Percent Dominant Taxa, %EPT=Percent EPT, Functional feeding groups---%_Coll=Percent Collector Taxa, %_Sc +Sh=Percent Scaper and Shredder taxa, # Pred=number of Predator taxa. MMI=multimetric macroinvert index, BLM and EPA Habitat Quality Index, LUI=Livestock Use Index, WW=stream wetted width, % Fine Sed= percent fine sediments in the reach, % Bare_gro= percent bare ground in the riparian area.

	T TAXA	EPT_ T	MTBI	%_Dom	%_Coll	%EPT	%_Sc +Sh	# Pred	MMI	BLM HQI	EPA HQI	LUI	WW	% Fine Sed	% Bare gro
AshCr_D	25	1	6.58	0.31	0.39	0.03	0.10	11	14	12	118	35	1.97	85	25
AshCr_U	12	0	7.21	0.51	0.34	0.00	0.00	8	8	9	85	37	1.65	100	75
BeaverCr	21	2	7.32	0.48	0.19	0.05	0.68	10	12	15	125	56	3.2	60	25
BloomCr	22	0	8.21	0.37	0.72	0.00	0.15	8	11	11	111	27	3	60	40
BrianSp1	23	1	5.70	0.21	0.41	0.19	0.20	11	17	17	143	33	0.95	44	10
BrianSp2	14	3	5.17	0.47	0.04	0.28	0.79	6	16	21	150	27	0.91	37	20
CharcoalCr	38	3	5.46	0.23	0.30	0.15	0.05	11	17	22	144	20	0.4	12.5	10
CowCrRes	34	2	7.38	0.35	0.61	0.07	0.05	17	11	17	125	18	25	100	0
CowCr_U	36	4	4.38	0.26	0.32	0.53	0.45	11	22	24	166	2	1.3	5	0
CowCr_L	34	3	4.69	0.25	0.69	0.26	0.02	15	17	16	124	13	2.44	32	0
LiscomBuD	10	0	5.49	0.80	0.88	0.00	0.08	3	5	20	126	3	0.25	50	0
LiscomBuU	31	0	5.91	0.45	0.70	0.00	0.13	10	13	12	94	28	2.2	97	20
OtterCr	38	4	6.73	0.17	0.66	0.02	0.17	13	15	20	153	4	3.1	30	20
RockyCrRes	12	0	6.77	0.66	0.70	0.00	0.18	4	7	9	125	0	10	100	0
StockerBr	27	4	5.19	0.30	0.24	0.43	0.48	8	20	19	142	8	0.67	10	5
TooleyCr	24	1	7.62	0.27	0.63	0.00	0.14	10	11	21	154	18	2.5	80	10

Table 5b. Metrics recorded during Herpetofauna and Plant Surveys used in the correlation analysis. AMPH Rep=potential for amphibian reproduction, EMVEGA=area coverage with emergent vegetation, GRAZ IMP =GRAZING IMPACTS (0 = None, 1 = Light, 2=Moderate, 3 = Heavy Structural Impact), Water D&DIV= Water Dammed or Diverted, WAT PERM=permanent or temporary water, # Herp Sp=total number of herpetofauna recorded at a site, BUWO=Woodhouse's toad breeding, AAm=any amphibian breeding, #NonNat =number of nonnative plants @ a site, Total=total # of plant species, % Native Plant species, # SOC =number of species of concern, # Nox= number of noxious weed species, FQAI= Floristic Quality Indices, # Wetland Obligate species, # of Facultative Wetland Species, # of A/B=number of annuals and biennials , % Peren =Percent Perennial Species.

	Metrics recorded during Herp Surveys								Metrics recorded during Plant Surveys									
	AMPH REP	EM_V EG_A	GRAZ IMP	Water D & DIV	WAT_ PERM	# Herp Sp	BUWO Breed	AAm_ Bred	# Non Nat	Total Spp	% Nati	# SOC	# Nox	FQAI	#_Wet Obli	# of FACW	# of A/B	% Peren
AshCr_D	0	1200	3	0	0	1	1	1	16	46	65.22	0	2	19.61	7	8	11	76.09
AshCr_U	1	120	2	0	1	1	1	1	11	26	57.69	0	0	12.36	7	1	11	57.69
BeavCr	1	900	1	0	1	2	0	1	0	0	0.00	0	0	0.00	0	0	0	0.00
BloomCr	1	400	1	0	0	3	1	1	9	23	60.87	0	0	12.51	5	3	6	73.91
BrianSp1	1	3	2	1	0	1	1	1	11	30	63.33	0	1	15.15	6	5	6	80.00
BrianSp2	0	0	2	1	0	0	0	0	0	0	0.00	0	0	0.00	0	0	0	0.00
CharcCr	0	8	2	1	1	0	0	0	11	46	76.09	0	3	25.80	13	9	7	84.78
CowCrRes	1	800	1	1	1	5	1	1	0	0	0.00	0	0	0.00	0	0	0	0.00
CowCr_U	0	108	1	0	0	0	0	0	13	43	69.77	1	2	22.42	3	9	8	81.40
CowCr_L	1	155	2	0	0	0	0	0	14	45	68.89	0	1	21.62	8	10	8	82.22
LiscBuD	0	0	1	1	0	0	0	0	0	0	0.00	0	0	0.00	0	0	0	0.00
LiscBuU	1	100	3	1	0	2	0	1	0	0	0.00	0	0	0.00	0	0	0	0.00
OtterCr	1	1800	1	0	1	1	0	1	12	29	58.62	0	1	13.00	7	4	5	82.76
RockyCrRe	1	500	0	1	0	1	0	1	10	21	52.38	0	2	11.13	3	6	5	76.19
StockerBr	0	0	1	0	0	0	0	0	9	38	76.32	1	1	24.01	1	4	5	86.84
TooleyCr	1	13	1	0	1	3	0	1	8	26	69.23	0	0	13.53	3	2	7	73.08

Table 6. Spearman's Rank correlation coefficient (R) table. Significant correlations at the α ≤ 0.05 level are underlined in red. Significant correlations at the α ≤ 0.01 level are shaded grey. Parameter abbreviations are explained in the methods section and previous table.

	T TAXA	EPT_ T	MTBI	% DOM	% COLL	% EPT	%_SC_S H	# PRED	MMI	BLM SITE	LUI	AMPH_R EP	EM VEG_A	GRAZ IMP	WATER _D_	WAT PERM	#_ HERP	A AM BRED	# NON NAT	T_SPP	% NATI
T_TAXA	1.00	0.60	-0.30	**-0.78**	0.07	0.32	-0.17	**0.80**	**0.68**	0.32	-0.37	0.03	0.28	0.05	-0.18	0.10	-0.32	-0.11	0.50	0.59	0.50
EPT_T		1.00	-0.55	-0.56	-0.44	**0.73**	0.45	0.41	**0.80**	0.67	-0.44	-0.36	0.19	-0.30	-0.22	0.07	-0.62	-0.54	0.29	0.42	0.32
MTBI			1.00	0.08	0.19	**-0.76**	-0.19	-0.09	**-0.61**	-0.55	0.51	0.57	0.39	-0.16	-0.38	0.50	**0.85**	**0.81**	-0.06	-0.23	-0.01
%_DOM				1.00	0.18	-0.34	0.08	**-0.82**	**-0.73**	-0.22	0.14	-0.17	-0.26	-0.05	0.32	-0.15	0.24	-0.11	**-0.71**	**-0.74**	**-0.75**
%_COLL					1.00	-0.49	**-0.69**	0.02	-0.48	-0.16	-0.41	0.37	0.07	-0.10	0.01	-0.14	0.34	0.18	0.01	-0.08	-0.02
%EPT						1.00	0.49	0.15	**0.84**	0.54	-0.40	-0.50	-0.35	-0.18	-0.07	-0.42	-0.66	**-0.69**	0.23	0.40	0.30
%_SC_SH							1.00	-0.24	0.37	0.34	0.20	-0.28	-0.01	-0.28	0.01	-0.12	-0.11	-0.23	-0.47	-0.39	-0.41
_PRED								1.00	0.53	-0.01	0.01	0.40	0.38	0.22	-0.38	0.20	-0.17	0.20	0.64	0.61	0.53
MMI									1.00	0.46	-0.27	-0.30	-0.04	0.04	-0.09	-0.26	-0.58	-0.40	0.43	0.56	0.46
BLM_SITE										1.00	-0.63	-0.50	-0.17	-0.46	0.22	0.05	-0.59	-0.63	-0.03	0.14	0.11
LUI											1.00	0.37	0.12	0.37	0.00	0.24	0.48	0.58	-0.23	-0.31	-0.31
AMPH_REP												1.00	0.20	-0.03	-0.26	0.34	0.54	**0.71**	0.00	-0.18	-0.01
EM_VEG_A													1.00	-0.04	-0.44	0.31	0.34	0.48	0.25	0.09	0.03
GRAZ_IMP														1.00	0.37	-0.25	-0.20	0.17	0.10	0.07	-0.10
WATER_D_															1.00	-0.24	-0.23	-0.26	-0.51	-0.42	-0.48
WAT_PE																1.00	0.13	0.34	0.03	0.01	0.12
NO_HERP_																	1.00	**0.72**	-0.20	-0.37	-0.21
AAM_BRED																		1.00	0.05	-0.17	-0.03
__NONNAT																			1.00	**0.95**	**0.91**
T_SPP																				1.00	**0.94**
%_NATI																					1.00

Table 6. (cont.) Spearman's Rank correlation coefficient (R) table. Significant correlations at α ≤ 0.05 level are underlined in red. Significant correlations at the α ≤ 0.01 level are shaded grey. Parameter abbreviations are explained in the methods scetion and previous table.

	# SOC	# NOX	FQAI	# WET OBL	#_OF_F AC	__OF_A _B	% PEREN	% BARE	EPA HBI	WW	% FINES
T_TAXA	0.28	0.67	0.60	0.47	0.69	0.25	0.56	-0.42	0.35	0.23	-0.46
EPT_T	0.56	0.52	0.47	0.14	0.48	0.04	0.37	-0.47	0.64	-0.05	-0.79
MTBI	-0.48	-0.45	-0.27	0.02	-0.44	0.10	-0.03	0.65	-0.35	0.62	0.62
%_DOM	-0.21	-0.59	-0.72	-0.57	-0.68	-0.52	-0.80	0.21	-0.48	-0.24	0.38
%_COLL	-0.31	-0.25	-0.13	0.03	-0.05	-0.04	0.02	-0.16	-0.05	0.13	0.16
%EPT	0.82	0.42	0.48	-0.09	0.48	0.09	0.30	-0.49	0.36	-0.30	-0.66
%_SC_SH	0.37	-0.19	-0.32	-0.61	-0.30	-0.52	-0.40	-0.16	0.18	0.11	-0.23
_PRED	-0.02	0.48	0.54	0.56	0.68	0.46	0.58	-0.16	0.35	0.36	-0.25
MMI	0.64	0.63	0.61	0.18	0.65	0.20	0.50	-0.47	0.58	-0.07	-0.63
BLM_SITE	0.40	0.38	0.21	-0.05	0.25	-0.20	0.13	-0.74	0.68	-0.28	-0.64
LUI	-0.47	-0.27	-0.36	-0.04	-0.33	-0.06	-0.35	0.57	-0.40	0.27	0.53
AMPH_REP	-0.47	-0.50	-0.23	0.07	-0.26	0.03	0.02	0.39	-0.11	0.57	0.35
EM_VEG_A	-0.22	0.12	-0.03	0.17	0.07	0.10	0.12	0.18	0.04	0.61	0.09
GRAZ_IMP	-0.37	0.20	-0.02	0.25	0.16	0.17	-0.12	0.20	-0.30	-0.22	0.36
WATER_D_	-0.30	0.01	-0.38	-0.10	-0.23	-0.53	-0.47	-0.25	0.01	-0.61	-0.05
WAT_PE	-0.30	0.01	0.01	0.34	-0.15	0.14	0.08	0.37	0.04	0.32	0.15
NO_HERP_	-0.42	-0.50	-0.40	-0.14	-0.43	-0.12	-0.18	0.48	-0.44	0.61	0.52
AAM_BRED	-0.47	-0.35	-0.26	0.03	-0.34	0.14	-0.01	0.57	-0.42	0.67	0.73
__NONNAT	0.21	0.65	0.88	0.76	0.83	0.92	0.92	0.04	0.18	0.06	-0.22
T_SPP	0.36	0.79	0.98	0.74	0.91	0.85	0.93	-0.15	0.29	-0.10	-0.39
%_NATI	0.34	0.60	0.94	0.70	0.74	0.85	0.99	-0.04	0.27	-0.01	-0.31
# SOC	1.00	0.31	0.46	-0.25	0.29	0.13	0.32	-0.34	0.03	-0.08	-0.39
__NOX		1.00	0.78	0.68	0.86	0.50	0.61	-0.35	0.26	-0.25	-0.48
FQAI			1.00	0.69	0.87	0.78	0.93	-0.20	0.31	-0.17	-0.47
__WETOBL				1.00	0.70	0.71	0.70	0.15	0.18	-0.12	-0.24
__OF_FAC					1.00	0.66	0.76	-0.38	0.38	-0.13	-0.53
__OF_A_B						1.00	0.82	0.29	-0.05	0.06	0.06
%_PEREN							1.00	-0.08	0.32	0.03	-0.37
%_BARE_G								1.00	-0.68	0.31	0.63
EPA_HBI									1.00	-0.22	-0.74
WW										1.00	0.39
%_FINES											1.00

The MTBI is perhaps the most responsive macroinvertebrate metric, significantly correlating with 11 of the other analyzed parameters, even the Livestock Use Index (LUI). The other significant associations with the LUI are % instream sediments and % bare ground in the reach, which are typical by-products of cattle trampling in the riparian area. Another macroinvertebrate metric that increases under degrading conditions is the % Dominant Taxa. Increases in this metric are negatively associated with most of the "good integrity" plant metrics: total # of plant species (R = -0.74), % natives (R = -0.75), the FQAI (R = -0.72), % Perennials (R = -0.80), # of facultative wetland species, etc. Only the MMI has more significant associations with the plant metrics. The macroinvertebrate multimetric community index (MMI) was significantly related to 9 non-autocorrelated parameters, positively correlating with the EPA HQI (R =0.58), total # of plant species (R =0.56), # of SOC plant species (R =0.64), the FQAI (R =0.61), % Perennials, # of facultative wetland species, and negatively correlated with the percent in-stream fine sediments (Table 6). EPT taxa measures are also positively correlated with the EPA HQI (R =0.64), # of SOC plants (R =0.82, p<0.01) and highly negatively related to % fine sediments (R =-0.79, p<0.01). This is an expected relationship because EPT taxa are usually intolerant to habitat disturbance and sedimentation. Thus, certain macroinvertebrate and plant attributes are responding to similar local reach conditions. The BLM habitat site score was positively correlated with the EPA HQI score (R = 0.68) and negatively correlated with % bare ground (R = -0.74), % instream fine sediments(R = -0.64), amphibian breeding potential (R = -0.52) and actual amphibian reproduction (R = -0.63). It seems that aquatic communities at this level are responding to the localized conditions; accordingly, over half of the aquatic macroinvertebrate community parameters correlated negatively with % instream fine sediments and positively with the Habitat Quality Indices. Increasing the wetted width of the stream (naturally by proceeding downstream, or impacted widening by cattle trampling the bank edge) leads to increased probability of amphibian breeding (R = 0.61), instream emergent vegetation area (R =0.57), overall number of herp species (R = 0.61), but also an increase in the MTBI (R =0.61), which signals an increase of macroinvertebrates tolerant to degraded conditions. Amphibians are responding more to the habitat site conditions and therefore, are correlating with few of the plant metrics. Although if the plant metrics were evaluated at the species coverage level, it is highly likely that there would be a significant relationship with breeding amphibians and *Carex nebrascensis*, which increases under grazing pressure, and is the dominant coverage in streams at heavily impacted spring sites.

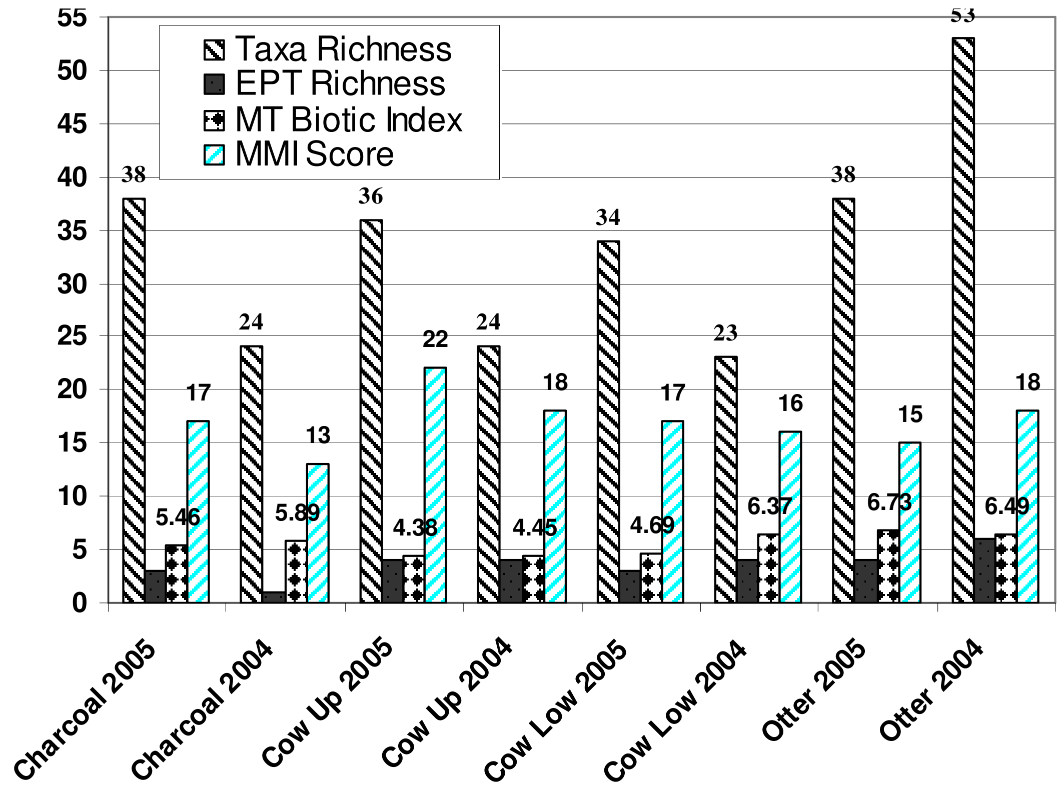
Overall, diverse, high biological integrity plant and macroinvertebrate communities, good vegetative riparian coverage, and high habitat quality scores with the EPA HQI are all significantly correlated. Number of herp species, breeding *Bufo woodhousii* and other breeding amphibians, high livestock use, and increased stream wetted width with more emergent instream vegetation, more tolerant macroinvertebrates, increased sedimentation and bare ground in the riparian area are also all significantly correlated.

Macroinvertebrate Reference Site Comparisons:

Three sites sampled in 2004 showed improved macroinvertebrate taxa metrics in the 2005 samples, while one site Otter Creek seems to have decreased in biointegrity (Figure 6). Charcoal Creek 2005 was further upstream from the 2004 site and the BLM HQI was much better at this new site, 22 vs. 17 (Table 3). Accordingly, 14 additional taxa were reported, and the new site's macroinvertebrate community ranked non-impaired compared to last years slightly-impaired MMI rank. The other 3 sites were sampled in the exact same reach and produced different macroinvertebrate taxa results (Figure

6). Cow Creek upper remained unimpaired, had similar MTBI scores, but gained 12 taxa from 2004. Cow Creek lower reported 11 additional taxa and greatly improved it's MTBI score from 6.37 to 4.59, therefore improving it's classification to the low end of unimpaired (Figure 6). Otter Creek reported 15 less taxa and declined in integrity based on the MTBI score increase causing a shift to the slightly-impaired category (Figure 6). Although, these temporal community changes are found in examining only 2 years of data. The stream reaches considered for reference sites in a biomonitoring program should be sampled annually to encompass all possible within-site variability, as they are compared to newly sampled sites elsewhere in the waterhed.

Figure 6. Reference site macroinvertebrate metric comparisons from 2004 and 2005



SITE COMMUNITY DISCUSSIONS

Cow Creek Site “Waterbed Bog”: Don Sasse directed us to this interesting area. The vegetation on this floating or raised mat includes the following herbaceous species: *Carex nebra*scensis (40% cover), *Carex hystericina* (20%), *Glyceria striata* (< 1%), *Glyceria elata* (< 1%), *Poa pratensis* (< 1%), *Juncus tenuis* (< 1%*), Poa interior* (< 1%) and *Sphenopholis obtusata* (< 1%). The surrounding tall shrub/small tree community which is influenced by the high water table includes *Crataegus succulenta*, *Cornus sericea, Prunus virginiana and Prunus americana*. All of these species are fairly typical of riparian communities in the area. Additionally, no mosses or other vascular plant species typical of fen or "bog" vegetation in the northern Rockies were present. During my site visit on June 27, 2005, I noted the vegetation mat to be intensively grazed with few flower/seed heads left on any of the grasses or sedges which makes species identification difficult, and cows were still hanging out beside the "bog". Canada thistle (*Cirsium arvense*), a state listed noxious weed, is present along the margins of the "bog" but not on the raised mat. No plant species of concern (SOC), amphibians or macroinvertebrates were found in the “bog”.

The high percent cover of *Carex nebrascensis*, which increases under grazing pressure is indicative of the current and past grazing history of the site. The site would key to a *Carex nebrascensis* Community Type in Hansen et al. (1995) which is a grazing disclimax community type; the riparian shrub community would be classified as a *Crataegus succulenta* Community Type (Hansen et.al. 1995).

I believe the sedge mat probably formed over a small spring/seep that provides a minor input of subsurface water to the area resulting in the saturated soils and the raised vegetation mat. The lack of mosses of any type at this site is in contrast to typical bogs/fens which develop in part as a result of moss growth and decomposition. However, it would be interesting to take a core sample of the mat to see if mosses were once present at the site and aided in the development of the raised mat that we see today. In general, true bogs do not exist in Montana due in part to our lack of summer precipitation (Chadde et al. 1998).

It would have been interesting to see what plant species the site supported prior to cattle grazing, perhaps it supported a more unique flora at one time, but now the vegetation is typical of many other partially disturbed riparian sites in the region.

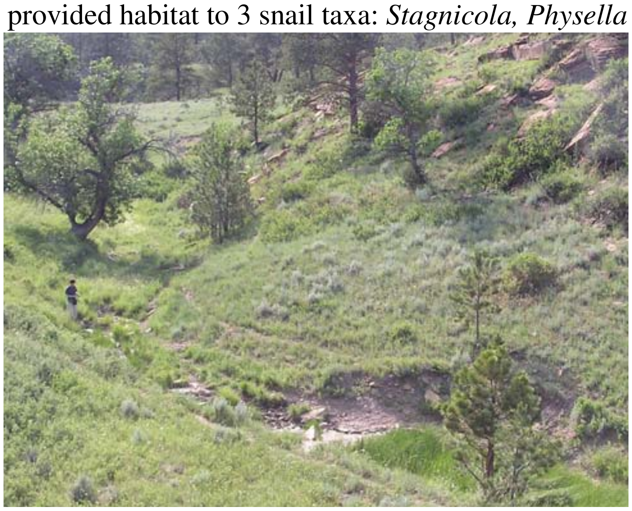
Though the hydrology of the area (perhaps in part due to the road) has created a unique little feature, the vegetation is not unique and in fact is typical of nearby riparian sites. Although, this may be a result of grazing induced succession. Additionally, no species typical of fens in the state were observed. With that said, it would be interesting to monitor the vegetation succession if cattle were excluded from the site.

SITE COMMUNITY DISCUSSIONS (CONT.)

Ash Creek Spring Area - The emergent vegetation community is classified as a *Scirpus pungens* Habitat Type. The riparian slope vegetation would be a *Symphoriocarpos occidentalis* Community Type. The cobble/boulder areas (left photo) contained the caddisfly, *Limnephilus,* while the widened cattle-hummocked area (right photo) had *Bufo woodhousii* breeding.

Ash Creek upstream site - *Pinus ponderosa/Cornus stolonifera* h.t. and a small area of the stream channel could be charcterized as a *Glyceria striata* d.t. (Hansen et al 1988). Seriously cattle-impacted, dominant invertebrates were tubificid worms, biting-midges (Ceratopogonidae) and air-breathing beetles.

Bloom Creek - *Symphoriocarpos occidentalis* c.t. and the de-watered stream channel would key to a *Scirpus pungens* h.t. Decent cobble substrate in areas between the cattle-crossings, these stable surfaces provided habitat to 3 snail taxa: *Stagnicola, Physella and Gyraulus,* the rest of the invert taxa were tubificid worms, tolerant midges (*Chironomus and Psectrocladius*), biting-midges, Ceratopogonidae and air-breathing beetles. Cattle-pocked areas had *Bufo woodhousii* breeding (right photo).



SITE COMMUNITY DISCUSSIONS (CONT.)

Brian Spring Sites- Most of the riparian area is a *Symphoriocarpos occidentalis* c.t. Brian Spring #2 is the left photo, Brian Spring #1 is on the right.

Cow Creek above the Reservoir- *Pinus ponderosa/Cornus stolonifera* h.t. Photo on the cover. Reference condition perennial spring stream

Cow Creek below the Reservoir- *Fraxinus pennsylvanica/Prunus virginiana* h.t. and the de-watered stream channel would key to a *Carex nebrascensis* c.t. (grazing dis-climax type) (Photo looking downstream at the right). This site has ecological potential to recover if cattle exclusion occurs. Most of the macroinvertebrate taxa of the upstream Cow Creek reference site are present, but so are many tolerant taxa in the cattle-hummocked areas.

Charcoal Creek (upstream of reservoir) - *Pinus ponderosa/Cornus stolonifera* h.t. Single thread channel in pretty good shape, mostly clean gravel/cobble substrate. A good integrity invertebrate site, except for a relatively higher number of tolerant organisms than the reference site (probably in the cattle crossing part of the reach. Numerous fingernail clams, *Pisidium* and *Sphaerium* (only site with this genus). This site was also the only site with the Dryopid beetle: *Helichus cf. lithophilus*. No amphibians of reptiles were reported here or in any other single thread, non cattle-hummocked stream.

O'Dell Reservoir: A dead Tiger Salamander was found washed up on the windward shore. A macroinvertebrate sample was taken here but not processed yet. *Ishnura and Enallagma/Coenagrion* damselflies and *Sympetrum sp*., dragonflies were flying along the shore, but I didn't bring my aerial net for adult collections.

Otter Creek - Stream channel is a *Scirpus acutus* h.t. and the riparian influenced slopes are a mosaic of *Symphoriocarpos occidentalis* c.t. and a *Poa pratensis* c.t.(grazing dis-climax type). Survey crews only reported the northern leopard frog during their survey, but in 2004, Don Sasse and I found a snapping turtle in this reach. A highly diverse macroinvertebrate site, but sedimentation, rushes (*Scirpus*, right photo lower left corner) and cattail encroachment are decreasing the channel depth and wetted width of sections of this reach. A photo by the botanist also revealed the 12-spotted skimmer dragonfly, *Libellula pulchella* perched on the *Scirpus.*

Stocker Branch Spring - Sideslopes are a *Pinus ponderosa/Cornus stolonifera* h.t. A macroinvertebrate sample was taken here, but not processed yet. This site appeared to contain the usual macrinvertebrate inhabitants of perennial spring sites that have a slightly impaired riparian area. No herpetofauna were found in the vicinity of the site.

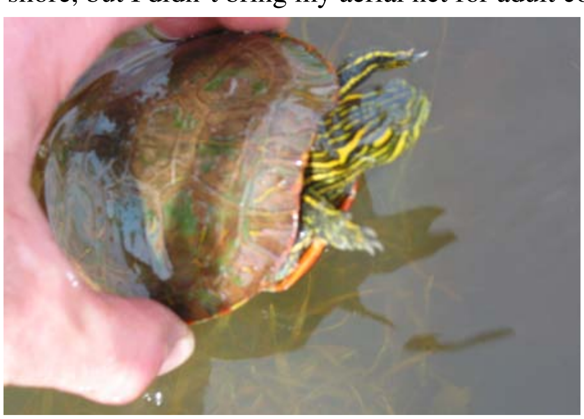
SITE COMMUNITY DISCUSSIONS (CONT.)

Stocker Branch - *Fraxinus pennsylvanica/Prunus virginiana* h.t. Reference condition macroinvertebrate community in the perennial spring stream reach. Could use cattle fencing to maintain the quality of the habitat.

Rocky Crossing Reservoir –a disturbed site even though it has been fenced off from cattle, it still harbors the effects of grazing past, a small part could be characterized as a *Salix exigua* c.t. and most of the area as a *Poa pratensis* c.t. During the invert survey (5/21/05), it seems to have been recently filled from the rains of early May (left photo), but virtually dry by July (right photo). The cattail areas may have already held pooled water, *Bufo woodhousii* and Boreal Chorus Frog were heard calling

in that area and the presence of 3 species of aquatic snails in the sample indicates perennial water. In the July herp surveys, Boreal Chorus Frog adults and juveniles were found. Twelve species of invertebrates were found in the qualitative 20-jab sample, including the fairy shrimp, *Branchinecta paludosa*. Co-occurring with the fairy shrimp were water boatman, Corixids, backswimmer waterbugs: Notonecta, *Aedes* sp. mosquito larvae and the pioneering Hydrophilidae and Dytiscidae beetles: *Hydroporus, Berosus, Oreodytes* and the Haliplidae beetle, *Haliplus*. These insects were recent colonizers, while the fairy shrimp were hatched from drought-resistent diapausing eggs and the mollusks probably present in the standing pools.

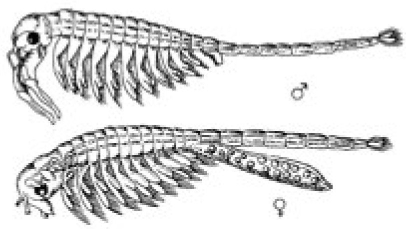
Taylor Creek Reservoir: Another dead Tiger Salamander was found washed up on the windward shore. Could this be related to the hundreds of cow pies (i.e. elevated nutrients or bacteria) that are in the recently refilled reservoir? Numerous painted turtles were seen in the northeast shallows (see left photo). *Bufo woodhousii*, *Rana pipens* and Boreal Chorus Frog were heard calling in the area on the 5/20/05 invert visit and 2 pairs of *Bufo woodhousii* were seen in amplexis. A macroinvertebrate sample was taken here but not processed yet. *Ishnura and Enallagma/Coenagrion* damselflies and *Anax junius* (Green darner) and *Sympetrum spp*.(Wandering gliders) dragonflies were flying along the shore, but I didn't bring my aerial net for adult collections.



SITE COMMUNITY DISCUSSIONS (CONT.)

Tooley Creek - riparian community-*Symphoriocarpos occidentalis* c.t. *Bufo woodhousii* and Boreal Chorus Frog were heard calling in the area on the 5/21/05 invert visit, and during the amphibian survey (5/28/05), 3 Boreal Chorus Frog adults, a gopher snake and an eastern racer were reported.

Fairy Shrimp Pools near Antelope Creek Well: These pools were visited on the way to another site when I noticed movement within the recently (~2 weeks) filled old stream channel. Upon investigation and a few dipnet sweeps, the common fairy shrimp: *Branchinecta paludosa* (see picture) was found to be highly abundant (thousands per sq. meter) in these isolated pools.



Co-occurring with the fairy shrimp were Ostracoda crustaceans, backswimmer waterbugs: Notonecta, and the pioneering Hydrophilidae beetles: Hydrobious and Berosus. These insects were recent colonizers, while the crustaceans were hatched from drought-resistent diapausing eggs that were lying dormant in the substrate.

Poker Jim Reservoir: Black bullhead were identified swimming in Poker Jim but none were collected. A macroinvertebrate sample was taken here but not processed yet. *Bufo woodhousii*, *Rana pipens* and Boreal Chorus Frog were heard calling in that area during the May 21st visit, and numerous *Bufo woodhousii* were witnessed in amplexus. At least 10 painted turtles, *Chrysemys picta*, were witnessed sunning on logs around the reservoir.

Hazel Creek Reservoir: Recently filled (5/21/2005) from the rains of 2 two weeks ago. A macroinvertebrate sample was taken, but only recent adult insect colonizers were present; water boatman, Corixidae and the pioneering Hydrophilidae beetles: Hydrobious and Berosus.
Bufo woodhousii were heard calling during the May visit, and 2 pairs of *Bufo woodhousii* were witnessed in amplexus.

CONCLUSIONS & RECOMMENDATIONS

In conclusion, the Cow Creek upper site, Stocker Branch and the 2005 Charcoal Creek site are recommended candidates for reference stream status against all small spring streams (1st-2nd order) in the Custer Forest. They were highest in overall macroinvertebrate and plant community and habitat integrity, except for the cattle usage in the Charcoal Creek and Stocker Branch riparian areas. Revisits to these sites from 2004, revealed a fairly consistent macroinvertebrate community that is stable across most water quality macroinvertebrate measures evaluated. These sites are inhabited by macroinvertebrate taxa found no where else in the Ashland District of the Custer National Forest. They represent isolated meta-populations that could recolonize other spring sites as restoration projects improve the habitat preferred by these more intolerant taxa. Furthermore, the only SOC plant species was found at these sites. Additional sites that have high ecological potential to recover to a biologically-intact condition, if cattle exclusion and stream restoration occur, include Cow Creek below the reservoir, Little Brian Spring #1, Brian Spring #2, Ash Creek Spring down, and 2004 sites, Davis Prong and South Fork Poker Jim Creek. The Otter Creek site would make a good reference site for the larger stream systems, although we do not have comparable sized replicate streams in the National Forest to compare. One recommendation would be to include a few more mid-sized streams (3rd order) in similar surveys in future years, such as sites on O'Dell Creek or Lee Creek if perennial reaches could be found that lie in the National Forest boundary.

Perennial spring stream sites with high riparian habitat quality and macroinvertebrate and plant biodiversity were not conducive to amphibians breeding or their presence. It is only after high-impact livestock use causes increased stream wetted width, more emergent in-stream vegetation and increased sedimentation do amphibians begin to use these spring areas, which naturally have narrow, single-thread channels and cobble substrate (see Appendix C). Numerous stock ponds and reservoirs, Cow Creek Reservoir for example, provide ample aquatic habitat and breeding areas for the propagation and life-cycle completion of the herpetofauna of the Ashland District of the Custer National Forest. Spring seeps and streams in there natural condition were probably always unattractive breeding areas for amphibians, and thus should be managed for their naturally occurring biota. Unfortunately, these macroinvertebrate species are intolerant to disturbance, and unless effective riparian management is performed (e.g. cattle fencing, bank stabilization and riparian buffer planting), eventually there will be no biologically-intact Northwestern Great Plains Perennial Spring Ecosystem type left in the Ashland District.

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Appendix A. Aquatic Invertebrate samples used in the calculation of metric scores collected in the Ashland Ranger District of the Custer National Forest, May 2005. TV=tolerance values & FG= functional feeding groups of the invertebrates, F of O= frequency of site occurrence

Class	Order	Family	Genus/Species	TV	FG	Liscom Butte Dn Quant 1/1	Liscom Butte UP Qual 1/2	Charcoal Creek Quant 9/16	Bloom Creek Quant 1/1	Rocky Creek Res. Qual 1/1	Brian Spring 1 Qual 1/1	Brian Spring 2 Quant 1/1	Cow Creek Upper Quant 5/6	Cow Creek Lower Quant 7/30	Beaver Creek Qual 1/1	Otter Creek Qual 1/10	Tooley Creek 3/4 Qual	Ash Creek Upper Quant 1/1	Ash Creek Lower Quant 1/1	F of O
Insecta	Ephemeroptera	Baetidae	Baetis tricaudatus	4	cg			73					149	3						**3**
Insecta	Ephemeroptera	Baetidae	Callibaetis	9	cg							1				3				**2**
Insecta	Ephemeroptera	Caenidae	Caenis latipennis	7	cg											5	0			**1**
Insecta	Plecoptera	Nemouridae	Amphinemura	2	cg			4					1							**2**
Insecta	Odonata	Aeshnidae	Aeshna	3	pr							4								**1**
Insecta	Odonata	Libellulidae	Leuccorhinia	8	pr						1									**1**
Insecta	Odonata	Libellulidae	Sympetrium	9	pr											1				**1**
Insecta	Odonata	Lestidae	Lestes	9	pr						6					11	52			**3**
Insecta	Odonata	Coenagrionidae	Argia	6	pr			46						13						**2**
Insecta	Odonata	Coenagrionidae	Enallagma	9	pr							2			3					**2**
Insecta	Hemiptera	Corixidae	(immature)	8	cg	1	3			2					6	8	115	1	7	**8**
Insecta	Hemiptera	Notonectidae	Buenoa	9	pr		1													**1**
Insecta	Trichoptera	Limnephilidae	Halesochila taylori	4	sh							3								**1**
Insecta	Trichoptera	Limnephilidae	Hesperophylax	3	sh			15					146	5	5	2				**5**
Insecta	Trichoptera	Limnephilidae	Limnephilus	3	sh						37	22			5				10	**4**
Insecta	Trichoptera	Limnophilidae	Psychoglypha	0	cg								5	147		5				**3**
Insecta	Coleoptera	Dryopidae	Helichus	4	sc		0	2	0	0	0	0	0	0	0	0	0	0	0	**1**
Insecta	Coleoptera	Dytiscidae	Agabus sp. 1	5	pr		1		5		41		8	2	1	21	1	1	9	**10**
Insecta	Coleoptera	Dytiscidae	Agabus sp.2	5	pr		2						9							**2**
Insecta	Coleoptera	Dytiscidae	Hydroporus	5	pr		11		2	4	7	1	6				1	2		**8**
Insecta	Coleoptera	Dytiscidae	Illybius	5	pr		2													**1**
Insecta	Coleoptera	Dytiscidae	Liodessus	5	pr		1										2		1	**3**
Insecta	Coleoptera	Dytiscidae	Oreodytes	5	pr					6							1		1	**3**
Insecta	Coleoptera	Dytiscidae	Rhanthus	6	pr		1													**1**
Insecta	Coleoptera	Helophoridae	Helophorus	8	sh		2		1		1			0	0		1		0	**4**
Insecta	Coleoptera	Haliplidae	Haliplus	5	sh		1			2	1	2		0	1					**5**
Insecta	Coleoptera	Haliplidae	Peltodytes	5	sh		2							0	0		1			**2**
Insecta	Coleoptera	Hydraenidae	Octhebius	5	pr		1													**1**
Insecta	Coleoptera	Hydrophilidae	Berosus	5	pr		11			10							1		2	**4**
Insecta	Coleoptera	Hydrophilidae	Laccobius	5	pr		1													**1**

Appendix A (cont.). Aquatic Invertebrate samples used in the calculation of metric scores collected in the Ashland Ranger District of the Custer National Forest, May 2005. TV=tolerance values & FG= functional feeding groups of the invertebrates, F of O= frequency of site occurrence

Class	Order	Family	Genus/Species	TV	FG	Liscom Butte Dn Quant 1/1	Liscom Butte UP Qual 1/1	Charcoal Creek Quant 9/16	Bloom Creek Quant 1/1	Rocky Creek Res. Qual 1/1	Brian Spring 1 Qual 1/1	Brian Spring 2 Quant 1/1	Cow Creek Upper Quant 5/6	Cow Creek Lower Quant 7/30	Beaver Creek Qual 1/1	Otter Creek Qual 1/10	Tooley Creek 3/4 Qual	Ash Creek Upper Quant 1/1	Ash Creek Lower Quant 1/1	F of O
Insecta	Coleoptera	Hydrophilidae	Coptotomus	5	pr			2												**1**
Insecta	Coleoptera	Hydrophilidae	Hydrobius	8	pr				1		4		5	1				4	1	**6**
Insecta	Coleoptera	Hydrophilidae	Tropisternus	6	pr	1			1		1					1		1		**5**
Insecta	Coleoptera	Elmidae	Dubiraphia	6	sc					0				0		2			0	**1**
Insecta	Coleoptera	Elmidae	Optioservus	5	sc			5		0			102	3					0	**3**
Insecta	Diptera	Ceratopogonidae	Athrichopogon	6	pr									1						**1**
Insecta	Diptera	Ceratopogonidae	Bezzia/Palpmyia	6	pr			24	5				1	10	1				15	**6**
Insecta	Diptera	Ceratopogonidae	Ceratopogon	6	pr	6							1		3	5		2		**5**
Insecta	Diptera	Ceratopogonidae	Culicoides	6	pr			4	10		6	5	4	33		1		74	97	**9**
Insecta	Diptera	Ceratopogonidae	Dasyhelaea	6	pr			134						4				5	18	**4**
Insecta	Diptera	Ceratopogonidae	Probezzia	6	pr			1	1		6	4		3	1				1	**7**
Insecta	Diptera	Chaoboridae	Chaoborus	7	pr	1					1									**2**
Insecta	Diptera	Chironomidae	Ablabesmyia	7	pr											8	1			**2**
Insecta	Diptera	Chironomidae	Chironomus	10	cg	5	3		102						0	59	16		2	**6**
Insecta	Diptera	Chironomidae	Cladotanytarsus	7	cg			1												**1**
Insecta	Diptera	Chironomidae	Corynonuera	7	cg		1	4			5				1	9				**5**
Insecta	Diptera	Chironomidae	Cricotopus bicinctus	7	cg				2					0		74				**2**
Insecta	Diptera	Chironomidae	Cricotopus trifacsia g	7	cg									0		30				**1**
Insecta	Diptera	Chironomidae	Cricotopus	7	cg				3					0			0			**1**
Insecta	Diptera	Chironomidae	Diamesa	5	cg	179	93													**2**
Insecta	Diptera	Chironomidae	Dicrotendipes	8	cg											8				**1**
Insecta	Diptera	Chironomidae	Eukiefferiella claripen	5	cg									1						**1**
Insecta	Diptera	Chironomidae	Heleniella	4	cg			26					1							**2**
Insecta	Diptera	Chironomidae	Micropsectra	4	cg			16			24		8	44	0	71	2		0	**6**
Insecta	Diptera	Chironomidae	Nilotanypus	7	cg			9								3				**2**
Insecta	Diptera	Chironomidae	Odontomesa	4	cg			1					6							**2**
Insecta	Diptera	Chironomidae	Orthocladius	6	cg			2						22	0		0			**2**
Insecta	Diptera	Chironomidae	Parakiefferiella	6	cg						5									**1**
Insecta	Diptera	Chironomidae	Parametriocnemus	5	cg			13			1		2			45	0		0	**4**
Insecta	Diptera	Chironomidae	Paraphaenocladius	5	cg								1		0				0	**1**
Insecta	Diptera	Chironomidae	Paratendipes	6	cg								2							**1**
Insecta	Diptera	Chironomidae	Paratanytarsus	6	cg		2				2	2			0	11	0			**4**
Insecta	Diptera	Chironomidae	Polypedilum	6	cg				4		2		1	11	0	6	0		0	**5**
Insecta	Diptera	Chironomidae	Procladius	9	pr										0	7	2			**2**
Insecta	Diptera	Chironomidae	Prodiamesa	3	cg								2							**1**
Insecta	Diptera	Chironomidae	Psectrocladius	8	cg		7		35	12					16	40	18	5	35	**8**
Insecta	Diptera	Chironomidae	Pseudodiamesa	6	cg								1	4						**2**
Insecta	Diptera	Chironomidae	Radotanypus	4	pr			1					31	26						**3**
Insecta	Diptera	Chironomidae	Rheocricotopus	4	cg			3												**1**
Insecta	Diptera	Chironomidae	Rheotanytarsus	6	cg			0						40						**1**
Insecta	Diptera	Chironomidae	Smittia/Psuedosmitti	6	cg		3				5		1				1			**4**
Insecta	Diptera	Chironomidae	Stenochironomus	8	sh					0						2				**1**
Insecta	Diptera	Chironomidae	Tanytarsus	6	cg				21		1			58		135	0			**4**
Insecta	Diptera	Chironomidae	Thiennimannimyia gr	6	pr			12					6	12						**3**
Insecta	Diptera	Chironomidae	Thiennimaniella	6	pr			8					1							**2**
Insecta	Diptera	Chironomidae	Tribelos	5	cg									2		2				**2**
Insecta	Diptera	Chironomidae	Tvetenia bavarica	5	cg			3					0							**1**
Insecta	Diptera	Culicidae	Culex	8	cg	1	12		1	93	8			0	0	0	154			**6**
Insecta	Diptera	Dixidae	Dixa	2	cg								1							**1**
Insecta	Diptera	Empididae		4	cg		1						1							**2**

Appendix A (cont.). Aquatic Invertebrate samples used in the calculation of metric scores collected in the Ashland Ranger District of the Custer National Forest, May 2005. TV=tolerance values & FG= functional feeding groups of the invertebrates, F of O= frequency of site occurrence

Class	Order	Family	Genus/Species	*TV*	*FG*	Liscom Butte Dn Quant 1/1	Liscom Butte UP Qual 1/2	Charcoal Creek Quant 9/16	Bloom Creek Quant 1/1	Rocky Creek Res. Qual 1/1	Brian Spring 1 Qual 1/1	Brian Spring 2 Quant 1/1	Cow Creek Upper Quant 5/6	Cow Creek Lower Quant 7/30	Beaver Creek Qual 1/1	Otter Creek Qual 1/10	Tooley Creek 3/4 Qual	Ash Creek Upper Quant 1/1	Ash Creek Lower Quant 1/1	F of O
Insecta	**Diptera**	**Dixidae**	**Dixa**	2	cg								1							**1**
Insecta	**Diptera**	**Empididae**		4	cg		1						1							**2**
Insecta	**Diptera**	**Ephyrdridae**	**Ephyrdra**	6	cg														48	**1**
Insecta	**Diptera**	**Psychodidae**	**Pericoma**	4	cg			20					1		1					**3**
Insecta	**Diptera**	**Pytchopteridae**	**Pytchoptera**	7	cg			1						1						**2**
Insecta	**Diptera**	**Simuliidae**	**Simulium**	6	fil			8						11	9	78				**4**
Insecta	**Diptera**	**Tabanidae**	**Chrysops**	5	pr									2						**1**
Insecta	**Diptera**	**Tabanidae**	**Tabanus**	7	pr				3					1	4				4	**4**
Insecta	**Diptera**	**Tipulidae**	**Tipula**	4	sh	6	6	3		0			6	0					2	**5**
Insecta	**Diptera**	**Tipulidae**	**Dicranota**	3	pr									1						**1**
Insecta	**Diptera**	**Tipulidae**	**Pseudolimnophila**	4	pr										1					**1**
Insecta	**Diptera**	**Tipulidae**	**Ormosia**	3	cg			2										1		**2**
Insecta	**Diptera**	**Stratiomyidae**	**Caloparyphus**	7	cg			2								2				**2**
Insecta	**Diptera**	**Sciomyziidae**		7	pr		1		5							1			4	**4**
Gastropoda	**Basommatophoi**	**Physidae**	**Physa/Physella**	8	sc			1	2	0			1	5	89	128	2		11	**8**
Gastropoda	**Basommatophoi**	**Lymnaeidae**	**Fossaria**	6	sc		3	3		9		44					17			**5**
Gastropoda	**Basommatophoi**	**Lymnaeidae**	**Stagnicola**	6	sc	12	5		36	3		1		0	3		50			**7**
Gastropoda	**Basommatophoi**	**Planorbiidae**	**Helisoma**	6	sc					0						1				**1**
Gastropoda	**Basommatophoi**	**Planorbiidae**	**Gyraulus**	6	sc		2		3	13				0	24	5	6		5	**7**
Gastropoda	**Basommatophoi**	**Planorbiidae**	**Planorbella**	6	sc					0							3			**1**
Gastropoda	**Neotaenioglossa**	**Hydrobiidae**		7	sc					0			1							**1**
Bivalva	**Veneroida**	**Sphaeridae**	**Sphaerium**	6	fi			11												**1**
Bivalva	**Veneroida**	**Sphaeridae**	**Pisidium**	8	fi			55					48	27					5	**4**
Hirudinea		**Glossosomatida**	**Glossophona complanata**	10	pr			1						10		2				**3**
Hirudinea		**Glossosomatida**	**Helobdella stagnalis**	10	pr															**0**
Hirudinea		**Erpobdellidae**		8	pr									1	2				2	**3**
Oligochaeta		**Tubificidae**		10	cg	13	18	1	33	3	25	1	1	10	10	5	48	42	20	**14**
Oligochaeta		**Lumbricina**		4	cg		1		0	0			1							**2**
Nematoda				5	pa		2	71	5				7		0		70	7	2	**7**
Arachnida	**Acari**			5	pr			1			1				0	1	1			**4**
Arachnida	**Acari**		**Lebertia**	5	pr								1	11						**2**
Malacostraca	**Amphipoda**	**Gammaridae**	**Hyallela**	8	cg				0	0	0			69	1	6	0	0	10	**4**
Malacostraca			**Brachinecta paludosa**	8	cg					1										**1**
Malacostraca	**Ostracoda**			4	sh		6			1		2							3	**4**
			# Individuals / Sample			225	207	589	281	159	191	94	571	594	187	804	566	145	315	
			TAXA RICHNESS			10	32	38	22	13	23	14	38	34	21	38	24	12	25	**111**
			EPT RICHNESS			0	0	3	0	0	1	3	3	3	2	4	1	0	1	

Appendix B. Raw data and metric calculation from riparian plant data collected from 2005. Lifeform=T-Tree, S-Scrub, G-Grasses, F-Forbs; Nativity=N-Native, I=Introduced; Rel_Cov=percent coverage at a site

Site	Cover	Date	Lifeform	Species	Nativity	Rel_Cov
Ash Creek	20	26-Jun-05	F	GLYSTR	N	0.2273
Ash Creek	10	26-Jun-05	T	FRAPEN	N	0.1136
Ash Creek	10	26-Jun-05	T	PINPON	N	0.1136
Ash Creek	10	26-Jun-05	G	POAPRA	I	0.1136
Ash Creek	10	26-Jun-05	S	SYMOCC	N	0.1136
Ash Creek	3	26-Jun-05	F	PRUVUL	N	0.0341
Ash Creek	3	26-Jun-05	S	RIBAUR	N	0.0341
Ash Creek	3	26-Jun-05	S	ROSWOO	N	0.0341
Ash Creek	1	26-Jun-05	F	ACHMIL	N	0.0114
Ash Creek	1	26-Jun-05	F	ALYALY	I	0.0114
Ash Creek	1	26-Jun-05	S	AMEALN	N	0.0114
Ash Creek	1	26-Jun-05	F	APOAND	N	0.0114
Ash Creek	1	26-Jun-05	G	BROJAP	I	0.0114
Ash Creek	1	26-Jun-05	G	BROTEC	I	0.0114
Ash Creek	1	26-Jun-05	G	Carex	N	0.0114
Ash Creek	1	26-Jun-05	G	CARLAN	N	0.0114
Ash Creek	1	26-Jun-05	G	CATAQU	N	0.0114
Ash Creek	1	26-Jun-05	F	CIRARV	I	0.0114
Ash Creek	1	26-Jun-05	F	CIRVUL	I	0.0114
Ash Creek	1	26-Jun-05	S	CORSER	N	0.0114
Ash Creek	1	26-Jun-05	T	CRASUC	N	0.0114
Ash Creek	1	26-Jun-05	G	ELEPAL	N	0.0114
Ash Creek	1	26-Jun-05	F	GALBOR	N	0.0114
Ash Creek	1	26-Jun-05	F	GLYLEP	N	0.0114
Ash Creek	1	26-Jun-05	G	HORJUB	N	0.0114
Ash Creek	1	26-Jun-05	F	LACSER	I	0.0114
Ash Creek	1	26-Jun-05	S	MAHREP	N	0.0114
Ash Creek	1	26-Jun-05	F	MEDLUP	I	0.0114
Ash Creek	1	26-Jun-05	F	MENARV	N	0.0114
Ash Creek	1	26-Jun-05	F	RANMAC	N	0.0114
Ash Creek	1	26-Jun-05	F	RANSCE	N	0.0114
Ash Creek	1	26-Jun-05	S	RHURAD	N	0.0114
Ash Creek	1	26-Jun-05	S	RHUTRI	N	0.0114
Ash Creek	1	26-Jun-05	S	RIBAME	N	0.0114
Ash Creek	1	26-Jun-05	F	RUMCRI	I	0.0114
Ash Creek	1	26-Jun-05	F	SISLOE	I	0.0114
Ash Creek	1	26-Jun-05	F	TAROFF	I	0.0114
Ash Creek	1	26-Jun-05	F	THLARV	I	0.0114
Ash Creek	1	26-Jun-05	F	TRADUB	I	0.0114
Ash Creek	1	26-Jun-05	F	VERAME	N	0.0114
Ash Creek	1	26-Jun-05	F	CAMMIC	I	0.0100
Ash Creek	1	26-Jun-05	F	CONARV	I	0.0100
Ash Creek	1	26-Jun-05	F	GEUMAC	N	0.0100
Ash Creek	1	26-Jun-05	F	PLAMAJ	I	0.0100
Ash Creek	1	26-Jun-05	S	SALBEB	N	0.0100
Ash Creek	1	26-Jun-05	F	THAOCC	N	0.0100

Appendix B (cont.). Raw data and metric calculation from riparian plant data collected from 2005. Lifeform=T-Tree, S-Scrub, G-Grasses, F-Forbs; Nativity=N-Native, I=Introduced; Rel_Cov=percent coverage at a site

Ash Spring	10	26-Jun-05	G	Carex	N	0.2041
Ash Spring	10	26-Jun-05	G	ELEPAL	N	0.2041
Ash Spring	10	26-Jun-05	G	SCIPUN	N	0.2041
Ash Spring	3	26-Jun-05	G	BROJAP	I	0.0612
Ash Spring	3	26-Jun-05	G	POAPRA	I	0.0612
Ash Spring	3	26-Jun-05	S	SYMOCC	N	0.0612
Ash Spring	1	26-Jun-05	T	ACENEG	N	0.0204
Ash Spring	1	26-Jun-05	F	ACHMIL	N	0.0204
Ash Spring	1	26-Jun-05	G	BROTEC	I	0.0204
Ash Spring	1	26-Jun-05	F	CAMMIC	I	0.0204
Ash Spring	1	26-Jun-05	F	GALAPA	N	0.0204
Ash Spring	1	26-Jun-05	G	JUNBUF	N	0.0204
Ash Spring	1	26-Jun-05	F	LACSER	I	0.0204
Ash Spring	1	26-Jun-05	F	MEDLUP	I	0.0204
Ash Spring	1	26-Jun-05	G	POAARI	N	0.0204
Ash Spring	1	26-Jun-05	G	PUCNUT	N	0.0204
Ash Spring	1	26-Jun-05	F	RANCYM	N	0.0204
Ash Spring	1	26-Jun-05	F	RANSCE	N	0.0204
Ash Spring	1	26-Jun-05	S	RIBAUR	N	0.0204
Ash Spring	1	26-Jun-05	S	ROSWOO	N	0.0204
Ash Spring	1	26-Jun-05	F	RUMCRI	I	0.0204
Ash Spring	1	26-Jun-05	F	SISLOE	I	0.0204
Ash Spring	1	26-Jun-05	F	TAROFF	I	0.0204
Ash Spring	1	26-Jun-05	F	THLARV	I	0.0204
Ash Spring	1	26-Jun-05	F	TRADUB	I	0.0204
Ash Spring	1	26-Jun-05	F	ZANPAL	N	0.0204
Bloom Creek	30	29-Jun-05	G	SCIPUN	N	0.5660
Bloom Creek	10	29-Jun-05	S	SYMOCC	N	0.1887
Bloom Creek	3	29-Jun-05	T	FRAPEN	N	0.0566
Bloom Creek	1	29-Jun-05	F	ACHMIL	N	0.0189
Bloom Creek	1	29-Jun-05	F	AMBPSI	N	0.0189
Bloom Creek	1	29-Jun-05	G	BROJAP	I	0.0189
Bloom Creek	1	29-Jun-05	G	CARLAN	N	0.0189
Bloom Creek	1	29-Jun-05	G	CARPRA	N	0.0189
Bloom Creek	1	29-Jun-05	F	CIRVUL	I	0.0189
Bloom Creek	1	29-Jun-05	G	ELEPAL	N	0.0189
Bloom Creek	1	29-Jun-05	F	GRISQU	N	0.0189
Bloom Creek	1	29-Jun-05	G	HORJUB	N	0.0189
Bloom Creek	1	29-Jun-05	F	MEDLUP	I	0.0189
Bloom Creek	1	29-Jun-05	F	MELOFF	I	0.0189
Bloom Creek	1	29-Jun-05	T	PINPON	N	0.0189
Bloom Creek	1	29-Jun-05	F	PLAMAJ	I	0.0189
Bloom Creek	1	29-Jun-05	G	POAARI	N	0.0189
Bloom Creek	1	29-Jun-05	G	POACOM	I	0.0189
Bloom Creek	1	29-Jun-05	G	POAPRA	I	0.0189
Bloom Creek	1	29-Jun-05	G	PUCNUT	N	0.0189
Bloom Creek	1	29-Jun-05	F	RUMCRI	I	0.0189
Bloom Creek	1	29-Jun-05	G	SCIACU	N	0.0189
Bloom Creek	1	29-Jun-05	F	THLARV	I	0.0189

Appendix B (cont.). Raw data and metric calculation from riparian plant data collected from 2005. Lifeform=T-Tree, S-Scrub, G-Grasses, F-Forbs; Nativity=N-Native, I=Introduced; Rel_Cov=percent coverage at a site

Brian Spring	10	22-Jul-05	G	ELEPAL	N	0.1695
Brian Spring	10	22-Jul-05	G	HORJUB	N	0.1695
Brian Spring	10	22-Jul-05	S	SYMOCC	N	0.1695
Brian Spring	3	22-Jul-05	F	AMBPSI	N	0.0508
Brian Spring	3	22-Jul-05	G	CARLAN	N	0.0508
Brian Spring	3	22-Jul-05	G	CARNEB	N	0.0508
Brian Spring	3	22-Jul-05	T	FRAPEN	N	0.0508
Brian Spring	3	22-Jul-05	G	POAPRA	I	0.0508
Brian Spring	3	22-Jul-05	G	Scirpus	N	0.0508
Brian Spring	1	22-Jul-05	F	ACHMIL	N	0.0169
Brian Spring	1	22-Jul-05	S	ARTCAN	N	0.0169
Brian Spring	1	22-Jul-05	F	ARTLUD	N	0.0169
Brian Spring	1	22-Jul-05	G	BROJAP	I	0.0169
Brian Spring	1	22-Jul-05	G	BROTEC	I	0.0169
Brian Spring	1	22-Jul-05	F	CIRARV	I	0.0169
Brian Spring	1	22-Jul-05	G	ELYREP	I	0.0169
Brian Spring	1	22-Jul-05	F	GLYSTR	N	0.0169
Brian Spring	1	22-Jul-05	F	MEDLUP	I	0.0169
Brian Spring	1	22-Jul-05	F	MONFIS	N	0.0169
Brian Spring	1	22-Jul-05	G	MUHASP	N	0.0169
Brian Spring	1	22-Jul-05	F	PLAMAJ	I	0.0169
Brian Spring	1	22-Jul-05	F	POLAVI	I	0.0169
Brian Spring	1	22-Jul-05	S	PRUVIR	N	0.0169
Brian Spring	1	22-Jul-05	G	PUCNUT	N	0.0169
Brian Spring	1	22-Jul-05	S	RIBAME	N	0.0169
Brian Spring	1	22-Jul-05	S	ROSWOO	N	0.0169
Brian Spring	1	22-Jul-05	F	RUMCRI	I	0.0169
Brian Spring	1	22-Jul-05	F	SISLOE	I	0.0169
Brian Spring	1	22-Jul-05	F	TRADUB	I	0.0169
Brian Spring	1	22-Jul-05	F	URTDIO	N	0.0169
Charcoal	10	28-Jun-05	S	CORSER	N	0.1563
Charcoal	10	28-Jun-05	T	PINPON	N	0.1563
Charcoal	10	28-Jun-05	G	POAPRA	I	0.1563
Charcoal	3	28-Jun-05	F	CIRARV	I	0.0469
Charcoal	3	28-Jun-05	F	GLYSTR	N	0.0469
Charcoal	3	28-Jun-05	S	ROSWOO	N	0.0469
Charcoal	3	28-Jun-05	S	SALBEB	N	0.0469
Charcoal	3	28-Jun-05	S	SYMOCC	N	0.0469
Charcoal	1	28-Jun-05	T	ACENEG	N	0.0156
Charcoal	1	28-Jun-05	G	Agrostis	N	0.0156
Charcoal	1	28-Jun-05	S	AMEALN	N	0.0156
Charcoal	1	28-Jun-05	G	CARHYS	N	0.0156
Charcoal	1	28-Jun-05	G	CARINT	N	0.0156
Charcoal	1	28-Jun-05	G	CARLAN	N	0.0156
Charcoal	1	28-Jun-05	G	CARNEB	N	0.0156
Charcoal	1	28-Jun-05	G	CARNEU	N	0.0156
Charcoal	1	28-Jun-05	G	CATAQU	N	0.0156
Charcoal	1	28-Jun-05	F	CERNUT	N	0.0156
Charcoal	1	28-Jun-05	F	CIRVUL	I	0.0156

Appendix B. Raw data and metric calculation from riparian plant data collected from 2005. Lifeform=T-Tree, S-Scrub, G-Grasses, F-Forbs; Nativity=N-Native, I=Introduced; Rel_Cov=percent coverage at a site. SOC species is bolded and underlined.

Charcoal	1	28-Jun-05	F	CONARV	I	0.0156
Charcoal	1	28-Jun-05	F	CYNOFF	I	0.0156
Charcoal	1	28-Jun-05	G	ELEPAL	N	0.0156
Charcoal	1	28-Jun-05	F	EPICIL	N	0.0156
Charcoal	1	28-Jun-05	G	EQULAE	N	0.0156
Charcoal	1	28-Jun-05	T	FRAPEN	N	0.0156
Charcoal	1	28-Jun-05	F	GALTRI	N	0.0156
Charcoal	1	28-Jun-05	F	GEUMAC	N	0.0156
Charcoal	1	28-Jun-05	F	HEURIC	N	0.0156
Charcoal	1	28-Jun-05	G	JUNTEN	N	0.0156
Charcoal	1	28-Jun-05	F	LYCAME	N	0.0156
Charcoal	1	28-Jun-05	F	MEDLUP	I	0.0156
Charcoal	1	28-Jun-05	F	MENARV	N	0.0156
Charcoal	1	28-Jun-05	G	POAJUN	N	0.0156
Charcoal	1	28-Jun-05	G	POAPAL	I	0.0156
Charcoal	1	28-Jun-05	F	POTARG	N	0.0156
Charcoal	1	28-Jun-05	F	RANSCE	N	0.0156
Charcoal	1	28-Jun-05	S	RIBAME	N	0.0156
Charcoal	1	28-Jun-05	S	Ribes	N	0.0156
Charcoal	1	28-Jun-05	F	RUMCRI	I	0.0156
Charcoal	1	28-Jun-05	G	SCIACU	N	0.0156
Charcoal	1	28-Jun-05	G	SCIMAR	N	0.0156
Charcoal	1	28-Jun-05	F	SISLOE	I	0.0156
Charcoal	1	28-Jun-05	F	TAROFF	I	0.0156
Charcoal	1	28-Jun-05	F	TRIREP	I	0.0156
Charcoal	1	28-Jun-05	F	VERAME	N	0.0156
Charcoal	1	28-Jun-05	F	Viola	N	0.0156
Cow Creek down	30	27-Jun-05	G	CARNEB	N	0.3371
Cow Creek down	10	27-Jun-05	G	POAPRA	I	0.1124
Cow Creek down	3	27-Jun-05	S	CORSER	N	0.0337
Cow Creek down	3	27-Jun-05	T	CRASUC	N	0.0337
Cow Creek down	3	27-Jun-05	T	FRAPEN	N	0.0337
Cow Creek down	3	27-Jun-05	F	GLYSTR	N	0.0337
Cow Creek down	3	27-Jun-05	T	PINPON	N	0.0337
Cow Creek down	3	27-Jun-05	T	PRUAME	N	0.0337
Cow Creek down	3	27-Jun-05	F	RORNAS	I	0.0337
Cow Creek down	3	27-Jun-05	S	ROSWOO	N	0.0337
Cow Creek down	3	27-Jun-05	S	SALBEB	N	0.0337
Cow Creek down	3	27-Jun-05	S	SYMOCC	N	0.0337
Cow Creek down	3	27-Jun-05	F	THADAS	N	0.0337
Cow Creek down	1	27-Jun-05	F	ACHMIL	N	0.0112
Cow Creek down	1	27-Jun-05	S	AMEALN	N	0.0112
Cow Creek down	1	27-Jun-05	G	BROJAP	I	0.0112
Cow Creek down	1	27-Jun-05	G	BROMAR	N	0.0112
Cow Creek down	1	27-Jun-05	G	CARLAN	N	0.0112
Cow Creek down	1	27-Jun-05	G	CARLEN	N	0.0112

Appendix B. Raw data and metric calculation from riparian plant data collected from 2005. Lifeform=T-Tree, S-Scrub, G-Grasses, F-Forbs; Nativity=N-Native, I=Introduced; Rel_Cov=percent coverage at a site. SOC species is bolded and underlined.

Cow Creek down	1	27-Jun-05	G	CATAQU	N	0.0112
Cow Creek down	1	27-Jun-05	F	CIRARV	I	0.0112
Cow Creek down	1	27-Jun-05	F	CIRVUL	I	0.0112
Cow Creek down	1	27-Jun-05	G	ELEPAL	N	0.0112
Cow Creek down	1	27-Jun-05	F	EPICIL	N	0.0112
Cow Creek down	1	27-Jun-05	F	GALAPA	N	0.0112
Cow Creek down	1	27-Jun-05	F	GEUMAC	N	0.0112
Cow Creek down	1	27-Jun-05	G	JUNENS	N	0.0112
Cow Creek down	1	27-Jun-05	G	JUNTEN	N	0.0112
Cow Creek down	1	27-Jun-05	F	LACSER	I	0.0112
Cow Creek down	1	27-Jun-05	F	MEDLUP	I	0.0112
Cow Creek down	1	27-Jun-05	F	MONFIS	N	0.0112
Cow Creek down	1	27-Jun-05	G	PHLPRA	I	0.0112
Cow Creek down	1	27-Jun-05	G	POAPAL	I	0.0112
Cow Creek down	1	27-Jun-05	F	POTGRA	N	0.0112
Cow Creek down	1	27-Jun-05	F	RANMAC	N	0.0112
Cow Creek down	1	27-Jun-05	S	RHUTRI	N	0.0112
Cow Creek down	1	27-Jun-05	S	RIBAME	N	0.0112
Cow Creek down	1	27-Jun-05	S	RIBLAC	N	0.0112
Cow Creek down	1	27-Jun-05	F	RUMCRI	I	0.0112
Cow Creek down	1	27-Jun-05	F	SISLOE	I	0.0112
Cow Creek down	1	27-Jun-05	F	TAROFF	I	0.0112
Cow Creek down	1	27-Jun-05	F	THLARV	I	0.0112
Cow Creek down	1	27-Jun-05	F	TRADUB	I	0.0112
Cow Creek down	1	27-Jun-05	F	VERAME	N	0.0112
Cow Creek down	1	27-Jun-05	F	Viola	N	0.0112
Cow Creek upper	20	27-Jun-05	T	CRASUC	N	0.1724
Cow Creek upper	20	27-Jun-05	G	POAPRA	I	0.1724
Cow Creek upper	20	27-Jun-05	S	SYMOCC	N	0.1724
Cow Creek upper	10	27-Jun-05	T	PINPON	N	0.0862
Cow Creek upper	10	27-Jun-05	S	RIBAME	N	0.0862
Cow Creek upper	10	27-Jun-05	S	ROSWOO	N	0.0862
Cow Creek upper	3	27-Jun-05	S	CORSER	N	0.0259
Cow Creek upper	3	27-Jun-05	F	GEUMAC	N	0.0259
Cow Creek upper	3	27-Jun-05	G	PHLPRA	I	0.0259
Cow Creek upper	1	27-Jun-05	G	BROJAP	I	0.0086
Cow Creek upper	1	27-Jun-05	G	BROMAR	N	0.0086
Cow Creek upper	**1**	**27-Jun-05**	**G**	**CARGRA**	**N**	**0.0086**
Cow Creek upper	1	27-Jun-05	G	CARMIC	N	0.0086
Cow Creek upper	1	27-Jun-05	G	CARPET	N	0.0086
Cow Creek upper	1	27-Jun-05	G	CARSPR	N	0.0086
Cow Creek upper	1	27-Jun-05	G	CATAQU	N	0.0086
Cow Creek upper	1	27-Jun-05	F	CIRARV	I	0.0086
Cow Creek upper	1	27-Jun-05	F	CIRVUL	I	0.0086
Cow Creek upper	1	27-Jun-05	F	CYNOFF	I	0.0086
Cow Creek upper	1	27-Jun-05	F	EPICIL	N	0.0086

Appendix B. Raw data and metric calculation from riparian plant data collected from 2005. Lifeform=T-Tree, S-Scrub, G-Grasses, F-Forbs; Nativity=N-Native, I=Introduced; Rel_Cov=percent coverage at a site. SOC species is bolded and underlined.

Cow Creek upper	1	27-Jun-05	G	FESOVI	I	0.0086
Cow Creek upper	1	27-Jun-05	T	FRAPEN	N	0.0086
Cow Creek upper	1	27-Jun-05	F	GEUALE	N	0.0086
Cow Creek upper	1	27-Jun-05	F	HACDEF	N	0.0086
Cow Creek upper	1	27-Jun-05	F	HERLAN	N	0.0086
Cow Creek upper	1	27-Jun-05	F	MELOFF	I	0.0086
Cow Creek upper	1	27-Jun-05	F	MONFIS	N	0.0086
Cow Creek upper	1	27-Jun-05	F	PLAMAJ	I	0.0086
Cow Creek upper	1	27-Jun-05	G	POAINT	N	0.0086
Cow Creek upper	1	27-Jun-05	G	POAPAL	I	0.0086
Cow Creek upper	1	27-Jun-05	F	POTARG	N	0.0086
Cow Creek upper	1	27-Jun-05	T	PRUAME	N	0.0086
Cow Creek upper	1	27-Jun-05	S	PRUVIR	N	0.0086
Cow Creek upper	1	27-Jun-05	F	PRUVUL	N	0.0086
Cow Creek upper	1	27-Jun-05	F	RANMAC	N	0.0086
Cow Creek upper	1	27-Jun-05	F	RANSCE	N	0.0086
Cow Creek upper	1	27-Jun-05	S	RHURAD	N	0.0086
Cow Creek upper	1	27-Jun-05	S	RIBLAC	N	0.0086
Cow Creek upper	1	27-Jun-05	F	RUMCRI	I	0.0086
Cow Creek upper	1	27-Jun-05	F	SISLOE	I	0.0086
Cow Creek upper	1	27-Jun-05	F	TRIHYB	I	0.0086
Cow Creek upper	1	27-Jun-05	F	URTDIO	N	0.0086
Cow Creek upper	1	27-Jun-05	F	Viola	N	0.0086
Otter Creek	20	27-Jun-05	G	SCIACU	N	0.2564
Otter Creek	20	27-Jun-05	G	SCIPUN	N	0.2564
Otter Creek	10	27-Jun-05	G	POAPRA	I	0.1282
Otter Creek	3	27-Jun-05	T	ACENEG	N	0.0385
Otter Creek	3	27-Jun-05	F	ASCSPE	N	0.0385
Otter Creek	3	27-Jun-05	F	CIRARV	I	0.0385
Otter Creek	3	27-Jun-05	G	ELYREP	I	0.0385
Otter Creek	3	27-Jun-05	G	HORJUB	N	0.0385
Otter Creek	3	27-Jun-05	F	SISLOE	I	0.0385
Otter Creek	1	27-Jun-05	G	AGRCRI	I	0.0128
Otter Creek	1	27-Jun-05	S	ARTCAN	N	0.0128
Otter Creek	1	27-Jun-05	G	BROINE	I	0.0128
Otter Creek	1	27-Jun-05	G	BROJAP	I	0.0128
Otter Creek	1	27-Jun-05	G	CARLAN	N	0.0128
Otter Creek	1	27-Jun-05	F	CHEALB	NI	0.0128
Otter Creek	1	27-Jun-05	G	ELEPAL	N	0.0128
Otter Creek	1	27-Jun-05	G	ELYHIS	I	0.0128
Otter Creek	1	27-Jun-05	F	MEDLUP	I	0.0128
Otter Creek	1	27-Jun-05	G	PHAARU	NI	0.0128
Otter Creek	1	27-Jun-05	F	PLAMAJ	I	0.0128
Otter Creek	1	27-Jun-05	G	PUCNUT	N	0.0128
Otter Creek	1	27-Jun-05	S	RIBAUR	N	0.0128
Otter Creek	1	27-Jun-05	F	RUMCRI	I	0.0128
Otter Creek	1	27-Jun-05	G	SCIMAR	N	0.0128
Otter Creek	1	27-Jun-05	F	SOLCAN	N	0.0128
Otter Creek	1	27-Jun-05	G	SPAPEC	N	0.0128
Otter Creek	1	27-Jun-05	S	SYMOCC	N	0.0128
Otter Creek	1	27-Jun-05	F	TRADUB	I	0.0128
Otter Creek	1	27-Jun-05	F	TYPLAT	N	0.0128

Appendix B. Raw data and metric calculation from riparian plant data collected from 2005. Lifeform=T-Tree, S-Scrub, G-Grasses, F-Forbs; Nativity=N-Native, I=Introduced; Rel_Cov=percent coverage at a site. SOC species is bolded and underlined.

Rocky Crossing Res	20	29-Jun-05	G	POAPRA	I	0.2500
Rocky Crossing Res	10	29-Jun-05	F	CIRARV	I	0.1250
Rocky Crossing Res	10	29-Jun-05	T	SALAMY	N	0.1250
Rocky Crossing Res	10	29-Jun-05	S	SALEXI	N	0.1250
Rocky Crossing Res	10	29-Jun-05	S	SYMOCC	N	0.1250
Rocky Crossing Res	3	29-Jun-05	G	ELYHIS	I	0.0375
Rocky Crossing Res	3	29-Jun-05	F	GLYLEP	N	0.0375
Rocky Crossing Res	3	29-Jun-05	G	POAPAL	I	0.0375
Rocky Crossing Res	3	29-Jun-05	T	POPDEL	N	0.0375
Rocky Crossing Res	3	29-Jun-05	S	SALERI	N	0.0375
Rocky Crossing Res	1	29-Jun-05	G	ALOAEQ	N	0.0125
Rocky Crossing Res	1	29-Jun-05	G	BECSYZ	N	0.0125
Rocky Crossing Res	1	29-Jun-05	G	ELEPAL	N	0.0125
Rocky Crossing Res	1	29-Jun-05	F	EUPESU	I	0.0125
Rocky Crossing Res	1	29-Jun-05	G	HORJUB	N	0.0125
Rocky Crossing Res	1	29-Jun-05	F	MELOFF	I	0.0125
Rocky Crossing Res	1	29-Jun-05	F	PLAPAT	N	0.0125
Rocky Crossing Res	1	29-Jun-05	F	RUMCRI	I	0.0125
Rocky Crossing Res	1	29-Jun-05	F	TAROFF	I	0.0125
Rocky Crossing Res	1	29-Jun-05	F	THLARV	I	0.0125
Rocky Crossing Res	1	29-Jun-05	F	TRADUB	I	0.0125
Stocker Branch	40	27-Jun-05	G	BROINE	I	0.2703
Stocker Branch	20	27-Jun-05	T	ACENEG	N	0.1351
Stocker Branch	20	27-Jun-05	T	FRAPEN	N	0.1351
Stocker Branch	10	27-Jun-05	T	CRASUC	N	0.0676
Stocker Branch	10	27-Jun-05	S	ROSWOO	N	0.0676
Stocker Branch	10	27-Jun-05	S	SYMOCC	N	0.0676
Stocker Branch	3	27-Jun-05	S	CORSER	N	0.0203
Stocker Branch	3	27-Jun-05	F	MONFIS	N	0.0203
Stocker Branch	3	27-Jun-05	G	PHLPRA	I	0.0203
Stocker Branch	3	27-Jun-05	T	PINPON	N	0.0203
Stocker Branch	3	27-Jun-05	G	POAPRA	I	0.0203
Stocker Branch	3	27-Jun-05	S	PRUVIR	N	0.0203
Stocker Branch	3	27-Jun-05	S	RIBAME	N	0.0203
Stocker Branch	3	27-Jun-05	F	TAROFF	I	0.0203
Stocker Branch	3	27-Jun-05	F	THADAS	N	0.0203
Stocker Branch	1	27-Jun-05	F	ACHMIL	N	0.0068
Stocker Branch	1	27-Jun-05	S	AMEALN	N	0.0068
<u>Stocker Branch</u>	**<u>1</u>**	**<u>27-Jun-05</u>**	**<u>G</u>**	**<u>CARGRA</u>**	**<u>N</u>**	**<u>0.0068</u>**
Stocker Branch	1	27-Jun-05	G	CARPET	N	0.0068
Stocker Branch	1	27-Jun-05	G	CARSPR	N	0.0068
Stocker Branch	1	27-Jun-05	G	CARTOR	N	0.0068
Stocker Branch	1	27-Jun-05	F	CYNOFF	I	0.0068
Stocker Branch	1	27-Jun-05	F	GALAPA	N	0.0068
Stocker Branch	1	27-Jun-05	F	GALBOR	N	0.0068
Stocker Branch	1	27-Jun-05	F	GEUALE	N	0.0068
Stocker Branch	1	27-Jun-05	F	GEUCAN	N	0.0068
Stocker Branch	1	27-Jun-05	F	HERLAN	N	0.0068

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Site	Cover	Date	Lifeform	Species	Nativity	Rel_Cov
Stocker Branch	1	27-Jun-05	F	LYCALB	I	0.0068
Stocker Branch	1	27-Jun-05	G	POAPAL	I	0.0068
Stocker Branch	1	27-Jun-05	F	POTGRA	N	0.0068
Stocker Branch	1	27-Jun-05	F	RANMAC	N	0.0068
Stocker Branch	1	27-Jun-05	S	RIBAUR	N	0.0068
Stocker Branch	1	27-Jun-05	S	RIBLAC	N	0.0068
Stocker Branch	1	27-Jun-05	F	SANMAR	N	0.0068
Stocker Branch	1	27-Jun-05	F	SCRLAN	N	0.0068
Stocker Branch	1	27-Jun-05	F	SISLOE	I	0.0068
Stocker Branch	1	27-Jun-05	F	TRADUB	I	0.0068
Stocker Branch	1	27-Jun-05	F	Viola	N	0.0068
Stocker Branch Spring	10	27-Jun-05	G	BROJAP	I	0.2174
Stocker Branch Spring	10	27-Jun-05	F	VERAME	N	0.2174
Stocker Branch Spring	3	27-Jun-05	G	CATAQU	N	0.0652
Stocker Branch Spring	3	27-Jun-05	S	CORSER	N	0.0652
Stocker Branch Spring	3	27-Jun-05	T	PINPON	N	0.0652
Stocker Branch Spring	3	27-Jun-05	G	POAPRA	I	0.0652
Stocker Branch Spring	1	27-Jun-05	S	AMEALN	N	0.0217
Stocker Branch Spring	1	27-Jun-05	G	CARDEW	N	0.0217
Stocker Branch Spring	1	27-Jun-05	G	CARMIC	N	0.0217
Stocker Branch Spring	1	27-Jun-05	F	CIRVUL	I	0.0217
Stocker Branch Spring	1	27-Jun-05	F	COLLIN	N	0.0217
Stocker Branch Spring	1	27-Jun-05	F	EPICIL	N	0.0217
Stocker Branch Spring	1	27-Jun-05	T	FRAPEN	N	0.0217
Stocker Branch Spring	1	27-Jun-05	F	GALAPA	N	0.0217
Stocker Branch Spring	1	27-Jun-05	F	GEUMAC	N	0.0217
Stocker Branch Spring	1	27-Jun-05	F	GLYLEP	N	0.0217
Stocker Branch Spring	1	27-Jun-05	F	HERLAN	N	0.0217
Stocker Branch Spring	1	27-Jun-05	G	JUNTEN	N	0.0217
Stocker Branch Spring	1	27-Jun-05	F	LACSER	I	0.0217
Stocker Branch Spring	1	27-Jun-05	F	MEDLUP	I	0.0217
Stocker Branch Spring	1	27-Jun-05	G	PHLPRA	I	0.0217
Stocker Branch Spring	1	27-Jun-05	G	POAPAL	I	0.0217
Stocker Branch Spring	1	27-Jun-05	F	PRUVUL	N	0.0217
Stocker Branch Spring	1	27-Jun-05	F	RANSE	N	0.0217
Stocker Branch Spring	1	27-Jun-05	S	RIBAME	N	0.0217
Stocker Branch Spring	1	27-Jun-05	S	ROSWOO	N	0.0217
Stocker Branch Spring	1	27-Jun-05	S	RUBIDA	N	0.0217
Stocker Branch Spring	1	27-Jun-05	F	RUMCRI	I	0.0217
Stocker Branch Spring	1	27-Jun-05	F	SISLOE	I	0.0217
Stocker Branch Spring	1	27-Jun-05	F	SOLCAN	N	0.0217
Stocker Branch Spring	1	27-Jun-05	G	SPHOBT	N	0.0217
Stocker Branch Spring	1	27-Jun-05	F	STECRA	N	0.0217
Stocker Branch Spring	1	27-Jun-05	F	THADAS	N	0.0217
Stocker Branch Spring	1	27-Jun-05	F	URTDIO	N	0.0217
Stocker Branch Spring	1	27-Jun-05	F	Viola	N	0.0217

Appendix B. Raw data and metric calculation from riparian plant data collected from 2005. Lifeform=T-Tree, S-Scrub, G-Grasses, F-Forbs; Nativity=N-Native, I=Introduced; Rel_Cov=percent coverage at a site. SOC species is bolded and underlined.

Site	Cover	Date	Lifeform	Species	Nativity	Rel_Cov
Tooley Creek	40	28-Jun-05	S	SYMOCC	N	0.4200
Tooley Creek	20	28-Jun-05	G	POAPRA	I	0.2100
Tooley Creek	10	28-Jun-05	G	ELYREP	I	0.1000
Tooley Creek	3	28-Jun-05	F	AMBPSI	N	0.0300
Tooley Creek	3	28-Jun-05	S	ARTCAN	N	0.0300
Tooley Creek	3	28-Jun-05	G	BROJAP	I	0.0300
Tooley Creek	3	28-Jun-05	G	POAJUN	N	0.0300
Tooley Creek	3	28-Jun-05	T	POPDEL	N	0.0300
Tooley Creek	3	28-Jun-05	S	ROSWOO	N	0.0300
Tooley Creek	1	28-Jun-05	F	ACHMIL	N	0.0100
Tooley Creek	1	28-Jun-05	G	CARPRA	N	0.0100
Tooley Creek	1	28-Jun-05	F	CHEPRA	N	0.0100
Tooley Creek	1	28-Jun-05	G	ELEPAL	N	0.0100
Tooley Creek	1	28-Jun-05	F	GLYLEP	N	0.0100
Tooley Creek	1	28-Jun-05	G	HORJUB	N	0.0100
Tooley Creek	1	28-Jun-05	T	JUNSCO	N	0.0100
Tooley Creek	1	28-Jun-05	F	LACSER	I	0.0100
Tooley Creek	1	28-Jun-05	F	LYCAME	N	0.0100
Tooley Creek	1	28-Jun-05	F	MEDLUP	I	0.0100
Tooley Creek	1	28-Jun-05	F	MELOFF	I	0.0100
Tooley Creek	1	28-Jun-05	F	MONFIS	N	0.0100
Tooley Creek	1	28-Jun-05	S	RHUTRI	N	0.0100
Tooley Creek	1	28-Jun-05	F	SISMON	N	0.0100
Tooley Creek	1	28-Jun-05	F	THLARV	I	0.0100
Tooley Creek	1	28-Jun-05	F	TRADUB	I	0.0100
Tooley Creek	1	28-Jun-05	F	TYPLAT	N	0.0100

Appendix C. Northwestern Great Plains Perennial Spring Ecological Description (Stagliano 2005).

Northwestern Great Plains Perennial Spring Ecosystem

Figure 30. Cow Creek (S005) reference spring example within the Custer National Forest.

Figure 31. Charcoal Creek Spring (S005) a slightly impaired example within the Custer National Forest.

Aquatic Ecological System Type: S005

Community Description

Summary:
This ecosystem is found in the moderate elevation (1000-1600m), upland hill areas of the Northwestern Great Plains. It occurs in small (0.2-2m) perennial, headwater springs with low to moderate gradient flowing through sedimentary geology. Benthic habitats are typically long riffle/ run reaches dominated by shale cobbles and gravel with some woody debris (see Figures above).

Environment:
Throughout its Montana range, it occurs in seeps and springs within the Custer National Forest, Wolf Mountains and the higher elevation Ponderosa pine forests of the Powder River Basin. Surface topography usually has a moderate gradient or sometimes undulating or hummocky. Disturbance by cattle is widespread, as these springs often represent the only water source in the uplands.

Fish Community: This is a fishless system.

Macroinvertebrate Community: The reference condition ecological system (S005) indicator macroinvertebrates include the midges - *Odontomesa, Radotanypus, Heleniella, Pseudodiamesa,* diptera - *Tipula, Dicranota, Ormosia, Pedicia*, the snails – Hydrobiidae and *Physa*; the Mayfly- *Baetis tricaudatus*, the caddisfly-*Hesperophylax designatus*, the water mite and leech-*Hydrachna* and *Glossophona complanata*, the Beetles-*Oreodytes, Optioservus and Hydroporus*, and the damselfly larva- *Argia*. Sediment impaired and cattle degraded springs will quickly lose the mayfly, caddisfly, and dipteran species (above), and form a community dominated by tolerant midges, biting dipteran larvae (Ceratopogonidae) and air breathing beetles.

Range:
The Northwestern Great Plains Perennial Spring Community type has been collected in the Custer National Forest, Wolf Mountains and the higher elevation Ponderosa pine forests of the Powder River Basin.

Management:
Grazing and livestock use around these springs should be limited to a stock tank; immediate spring areas should be fenced to avoid cattle intrusions. Soils adjacent to the springs are often waterlogged and are easily trampled and hummocked by livestock, causing severe streambed degradation, sedimentation and siltation downstream.

Global Rank: GU **State Rank**: S4

Global Rank Comments:
The number of occurrences is unknown. In Montana, this ecosystem is reported from 25 site visits within the Custer National Forest Ashland District, but only three of these sites contained a quality, fully functional S005 community (Stagliano 2004 & 2005). In a similar ecological type, the caddisfly, *Hesperophylax designatus* was also found to be an indicator species of perennial springs in the Glass Mountains of the Great Basin (UT) in a 1994 survey (Myers 1995). Therefore, this ecosystem may be widespread, but because of the limited occurrence of high integrity sites in Montana, should probably be evaluated for long-term monitoring, and restoration of degraded sites.